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Issue #265

73®

Amateur Radio's Technical Journal

A Wayne Green Publication

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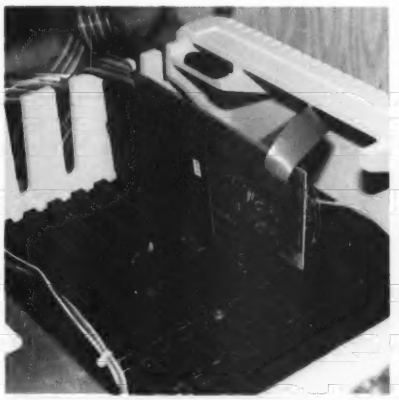

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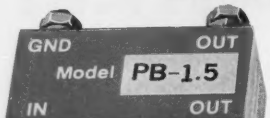

Model	Ratio	Matches 50 ohms to
PB-1	1:1	50 ohms
PB-1.5	1.5:1	75 ohms
PB-2	2:1	100 ohms
PB-3	3:1	150 ohms
PB-4	4:1	200 ohms
PB-5	5:1	250 ohms
PB-6	6:1	300 ohms
PB-7.5	7.5:1	375 ohms
PB-9	9:1	450 ohms
PB-12	12:1	600 ohms
PB-16	16:1	800 ohms

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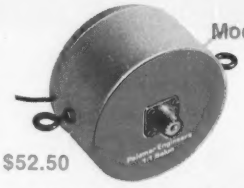

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77.0 XB	100.0 1Z	131.8 3B	173.8 6A
79.7 SP	103.5 1A	136.5 4Z	179.9 6B
82.5 YZ	107.2 1B	141.3 4A	186.2 7Z
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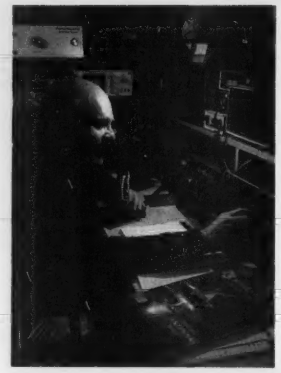

W2NSD/1
NEVER SAY DIE

editorial by Wayne Green

THE OLD MAN

With my 60th birthday coming up September 3rd, I find myself retrospecting... and wondering how much time is left. I can't complain, for I've enjoyed putting out *73 Magazine* for the last 22 years and I've had the excitement of being there when many of the interesting things happened.

Back when I first got into amateur radio, I used to go to the hamfests and be amazed at Ted McElroy and his ability to copy high-speed code. What a show he put on! He'd tune in some code at around 50 wpm and talk with the people around him for awhile, then turn to his typewriter and make it sound like a 100-word-per-minute Teletype™ machine. As I recall, Ted not only was the fastest man in the world in copying code, but I think he had some speed records in typing, too. Heady stuff for a kid.

Then, soon after the war, I happened to be in the right place at the right time to participate in some of the early narrowband FM experiments. I modified an old SCR-274 transmitter and a Meisner Signal Shifter with reactance modulators and had a ball. Of course, I'd been building ham gear since 1937 (golly, that's 45 years ago!), so my ham shack was piled high with equipment by 1946. I still have hams say hello at hamfests who visited my shack in those days and marveled at the collection of things I'd bought (surplus) and built. I loved to build.

The true old-timer is the chap who made tube socket holes in steel chassis by first drilling a small hole and then enlarging it with a rat-tail file for the socket. Oh, there were socket punches, but they were darned expensive. It was a long time before I managed to buy a set of those elite tools.

Then there was John Williams W2BFD, the grandpappy of ham RTTY. Oh, others helped, but it was John that really got it all started. He did most of the early experimenting, arranged to get the equipment, distributed it, and wrote articles about it. It was his work that got me going on RTTY in 1948, which in turn got me to start a RTTY magazine back in 1951. I've been editing and publishing ever since. John was a cranky, sneaky old man, and he was a good friend. It's a shame he died in 1961, for he would have loved solid state and ICs. But he didn't take care of himself (smoked), so one day he keeled over. He lived and died for amateur radio.

Then there was Sam Harris W1FZJ, another irascible genius and a good friend. Sam made the first practical parametric amplifier. He also did a lot of the early moonbounce hamming, culminating in his working for the big dish folk at Arecibo.

On the other side of the coin, I had the fun of knowing Don Miller rather well... and getting sued by him when I blew the whistle on his false DXpeditions. I've never written the entire story of *that* one, but I should. No, that's not the same Don Miller that got shafted by the League a couple years ago... different chap. The older Miller is, I believe, in prison in California for trying to get some chap to kill his wife. The League Miller is, I understand, about to run for director again. That should be an interesting election. Since, as far as I could discover, he was kicked out of the job on a trumped-up charge, I'd like to see him win this one. And I say that despite some of the unkind things Don has said about me at ham clubs.

Even after 45 years of ham radio, I still get a kick out of getting on 20m and making contacts... either around the US or with some good DX. A couple years ago I was out there climbing our mighty Mount Monadnock to get at the head of the line for 10-GHz DXing, with seven states contacted. No one has come close to equalling the record yet. That was hard work... and fun. I think the mountain climbing may have taken a year off my life... but that is nothing compared to the dent my first wife made in it.

Just managing to survive with *73* for all these years has been a miracle. Remember that I'd just really gotten started with it when the "incentive licensing" debacle hit in 1963 and stopped the growth of amateur radio for 10 years. That's when three-quarters of the ham dealers and 95% of the manufacturers went out of business. At one time the magazine staff was down to five people, working day and night to try to keep things going.

With the ham industry picking up a bit due first to FM and repeaters and then from an influx of CBers, I kept things going. The invention of the microcomputer sparked me to start *Byte* magazine... and then *Kilobaud*, Instant Software, *Selling Micros*, *80 Micro*, Load 80, and *Desktop Computing*. We went from a few people to a staff on the order of 250, with buildings all around town. We still have more magazines in the works with no end in sight.

One of the benefits of getting the business to this size is that my ideas have a better chance of getting attention. I suppose that at 60 I should start to slack off and not work so hard. I still put in a hundred-hour work week and keep up with reading some 200 or so magazines a month ... plus a few books. Add that to my travel schedule to hamfests, computer shows, and to give talks. I count 18 shows so far just this year, nine talks, several Washington trips for NIAC, a couple of consulting trips, and a short visit to Colombia. Not bad when you consider we're only into July at this writing.

Yes, partly I'm bragging. But that isn't all of it. I do want you to know that I'm doing all this with a goal in mind of providing you with a magazine which is interesting, which will, I hope, inspire you to enjoy amateur radio more, and which may bring education to more of the world. I feel that I'm doing the best I can and I hope that you'll help me towards my goals with subscriptions, with articles, and by getting youngsters into amateur radio.

Though I've got a wonderfully supporting bunch of people working with me, we need more help. We're getting a big new magazine started this fall and would like to start some more next year, if we can get the people to help with the work. We have a wondeful bunch of people who are enjoying what they

ATTENTION, AUTHORS!

73 Magazine is always searching for good articles, and now may be your chance to share the fame and fortune enjoyed by hundreds of other readers-turned-authors. We are looking for construction articles, antenna articles, club project articles, and so forth. Articles on any subject dealing with amateur radio are considered, but our primary emphasis is on construction. If you need help in getting your manuscript up to snuff, we will send you a copy of "How to Write for *73*" (free for an SASE). Please send your request or manuscript to: Editorial Offices, *73 Magazine*, Peterborough NH 03458.

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- 6 memory channels.

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- High performance noise blanker.
- RF gain control. • RIT circuit.

Optional accessories:

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- PS-20 Fixed station power supply (TR-9500 only).
- SP-120 External speaker.
- TK-1 AC adapter for memory back-up.

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do...and are learning. There isn't a better part of the whole world in which to live than New Hampshire.

While I enjoy publishing the magazines, my main goal is to try to get American technology so we can catch up with Japan. To this end I believe we need a monumental growth of amateur radio, attracting the teenagers to the hobby. Then we need better colleges to teach them and turn them loose to build new businesses and provide us with the telecommunications and computers we are going to need in the next ten and twenty years.

With your help, I think we can get the amateur rules so they are better in tune with the type of technical enthusiast we need. With your help, we can get ham clubs going in every high school in the country. With your help, we can set up a pilot model of the college that is needed... and then help it proliferate. Has anyone franchised colleges yet?

At Comdex, the computer show in Atlantic City a couple of weeks ago, I was most pleased to meet so many computer company presidents who walked up to me and gave me their call letters. I wasn't surprised, for amateur radio gives a youngster a tremendous head start over everyone else when it comes to a technical career.

I've got to lose about ten pounds I put on eating at the shows and I've got to spend some time getting in shape for skiing this winter. That, plus getting a new magazine going and hitting the show circuit again this fall, should keep me busy. Do I hear any interest from readers in joining me on the show trip to Tokyo, Seoul, Taipei, Hong Kong...and on to 9V1, 9M6, VS5, 9M8, DU?

THE NON-DXPEDITION

Some 700 DXers who worked KF1O portable on CE0X on San Felix Island (off Chile) were somewhat upset recently when the League discredited the operation. One of the DX bulletins had further details. It was reported that the Chilean government had claimed the documents as forgeries. The Chilean club was up in arms about the whole situation.

A day or so later I received a letter mailed from Greece from Bob Read KF1O with copies of some CE0X documents but no explanation. These papers were copies of copies, so there

Continued on page 100

Well...I Can Dream, Can't I? **by Bandel Linn K4PP**

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The Memory Keyer that started a revolution in CW

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AM-422R1

The Splattometer

—visual overmod warning

Ed. Note: "The Splattometer" was one of the honorable mention winners in our Home-Brew Contest. W1BG will be receiving a $50 bonus in addition to his normal article payment.

Penn Clower W1BG
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The most common way to abuse a sideband signal at the transmitter is by overdriving the output amplifier. That generates splatter, spurious signals which can cause interference up to 50 kHz or more from the normal transmission frequencies.

The "Splattometer" connects easily into the transmission line, monitors the output signal, and flashes a warning lamp whenever it detects flattopping. An entirely new type of signal analyzer, it is a real help in getting the most power from a transmitter while minimizing splatter. The entire instrument, including the built-in ac power supply, can be built for $65 using all new Radio Shack components, or for much less if your junk box isn't completely empty.

Amplifiers used in sideband transmitters are linear amplifiers. That means the output signal, aside from being more powerful, should be an exact replica of the input signal. Amplifiers have limits, however, and overdriving one can cause it to exceed its linear range so that the peaks of the output waveform get clipped or flattened. These flattops cause the signal to splatter extra energy onto adjacent frequencies.

Splatter can be hard to control for several reasons. Operators naturally want to run their transmitters at full power, and that often leads to running the microphone gain too high. An swr-type power-output monitor will show more output power, but unfortunately much of that extra power is spread up and down the band.

Monitoring a transmitter for splatter until now also has posed a problem since it required the use of an oscilloscope. That solution can be complex and expensive. As a compromise, most hams leave the microphone gain control set at some customary point and hope the ALC is working well enough to avoid splatter. For some people that works and for some it doesn't. It usually doesn't work at club stations where operators may not be too familiar with the equipment, and it usually doesn't work during contests when the race is on and every Watt counts.

Photos by W1GSL

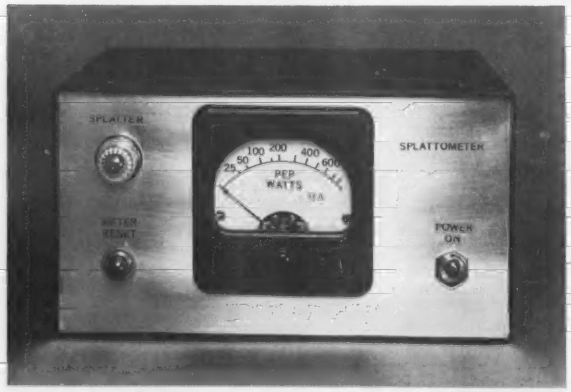

Photo A. The uncluttered 4" by 7½" front panel is dominated by the PEP wattmeter and splatter-alarm lamp. Only two operating controls are required, a power switch and reset push-button.

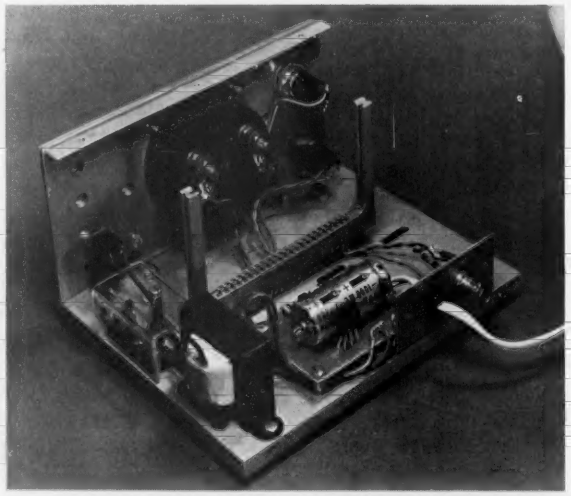

Photo B. Interior view of the recycled cabinet. The main circuit card plugs into the empty card socket while the power supply is mounted separately. Note that the rf voltage divider resistors are mounted directly on the input connector. A plastic shield keeps stray fingers off the ac line fuse.

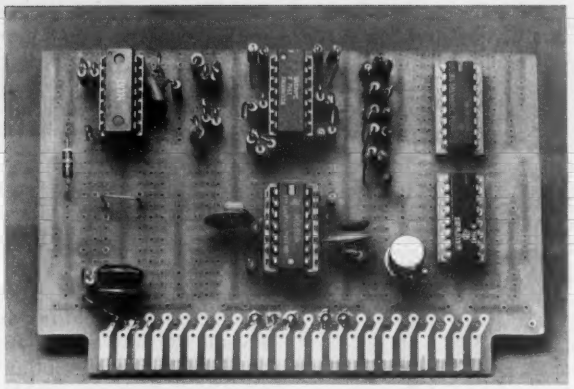

Photo C. Five ICs and the lamp driver transistor pack a lot of functions into a small space. The rf detector/filter components are grouped by themselves in the lower left-hand corner of the board. From left to right across the board are the quad op amp, quad comparator and dual timer, and finally the two up/down counters. One-quarter Watt resistors and miniature capacitors are mounted on end to save space.

Photo D. Although it fits nicely on top of the transceiver, the Splattometer can be placed anywhere within the operator's field of view. It doesn't need constant attention; when you splatter, it lets you know with a bright flash.

The "Splattometer" is a much better alternative. This simple flattop-monitor and -alarm circuit is usable over a wide range of transmitter power levels. The circuit basically consists of two sections. The first measures the peak voltage present in the transmitter signal. The second section measures how long the transmitter output has been at that maximum level. A clean SSB signal will just peak briefly to the transmitter's maximum output, but a splattering signal will be clipped and so stay at that level for a longer time. That time at maximum power is detected by the circuit and triggers the splatter indicator.

How It Works

A block diagram of the circuit is shown in Fig. 1. The antenna cable is looped through the unit and a small portion of the rf voltage is sampled with a restive divider. This signal is rectified and lightly filtered to create an accurate audio frequency reproduction of the rf envelope.

The peak-voltage measuring portion of the instrument is built around an up/down counter and simple six-bit digital-to-analog (D/A) converter. The converter output is a dc voltage nominally equal to the peak level of the detected rf waveform. If the detected level peaks higher than the existing D/A output, the counter gets clocked a step higher, thus raising the D/A output voltage. This feedback-controlled up-counting by itself would eventually set the converter output just above the rf peak voltage.

The counter, however, is also being clocked downward about two steps every second; as a result, the D/A converter output tracks within one or two steps (about .2 volts) of the detected peak envelope level. A threshold circuit freezes the counter state when the rf signal disappears between words, sentences, or transmissions. The dc measurement of the peak signal level also drives a simple voltmeter whose scale is calibrated to show the PEP Watts the transmitter is delivering to a 52-Ohm load. Notice that the relatively crude 6-bit D/A converter is perfectly acceptable since the feedback around the counter automatically adjusts the dc output to match the peak input. The actual counter state and converter linearity simply don't matter.

The flattop-detection portion of the Splattometer starts by low-pass-filtering the detected rf envelope with a one-millisecond time constant. This means that if the rf envelope suddenly jumps from zero to maximum, the filter outputs will take about three milliseconds to follow it. The splatter indicator is triggered whenever the output of this filter is greater than 80% of the measured peak signal level. The 80% and 1-ms time constant were chosen so that the instrument will detect any flattop lasting longer than 2 ms.

The output indicator is a panel lamp driven by an IC timer which generates a .1-second-long pulse whenever a flattop is detected.

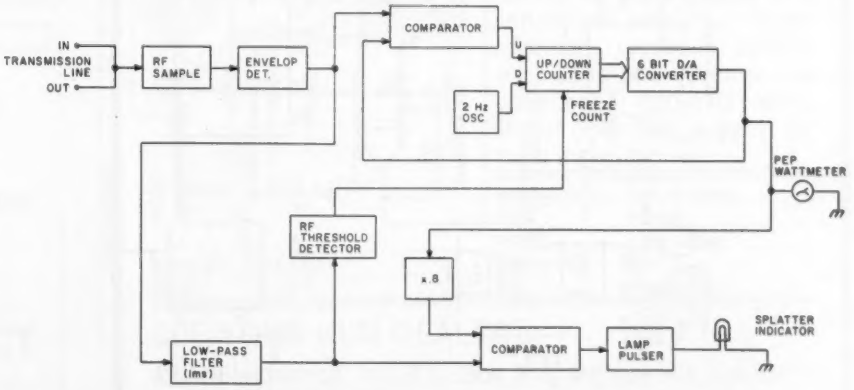

Fig. 1. Splattometer block diagram.

The .1-second pulses are just long enough to produce a bright eye-catching flash on each detection. This visual alarm works well.

One of the nicest features of the Splattometer is that you don't have to concentrate on watching it the way you would an oscilloscope. It just sits quietly off to the side until you start talking too loudly and then *Flash!*, it grabs your attention. A useful modification of the output indicator, particularly for sightless hams, would be to replace the lamp with a 4.8-kHz piezoelectric buzzer. The operator would certainly hear the buzzer, but its frequency would be too high to get past the transmitter's SSB generator.

The complete circuit diagram is shown in Fig. 2. The circuit proper uses just five ICs, and the power supply contains a sixth for 5-volt regulation. An LM324 quad op amp is used to buffer the several RC filtered signals and acts as the D/A output amplifier. A quad LM339 comparator gates the counter-up, counter-hold, and splatter-detection signals. The last comparator section is used in the 2-Hz countdown oscillator. One section of a 556 dual timer generates the output indicator pulses while the other prevents the counter state from underflowing from zero to all ones. That second timer section can also be triggered by the front panel push-button to reset the counter to zero. The reset button isn't used much except at power turn-on when the counter is likely to come up in an unrealistically high state.

The counter uses two 74LS193s. The standard 74193 chips will work just as well, but the extra 10¢ cost per chip seemed like a worthwhile expense in terms of reduced power consumption. The D/A converter is an R-2R ladder made entirely with 22k resistors. Five-percent resistors were used without problem, although the conversion linearity is poor. That doesn't matter, as mentioned earlier, and the 64 output levels are adequate for proper circuit operation.

The simple power supply has one unusual feature. The main circuit board requires 12 to 20 volts at 10 mA or so and 5 volts at 45 mA. Those needs are easily met with the 1000-uF filter capacitor and the 5-volt regulator. The indicator bulb draws about 150 mA, though, and if taken from

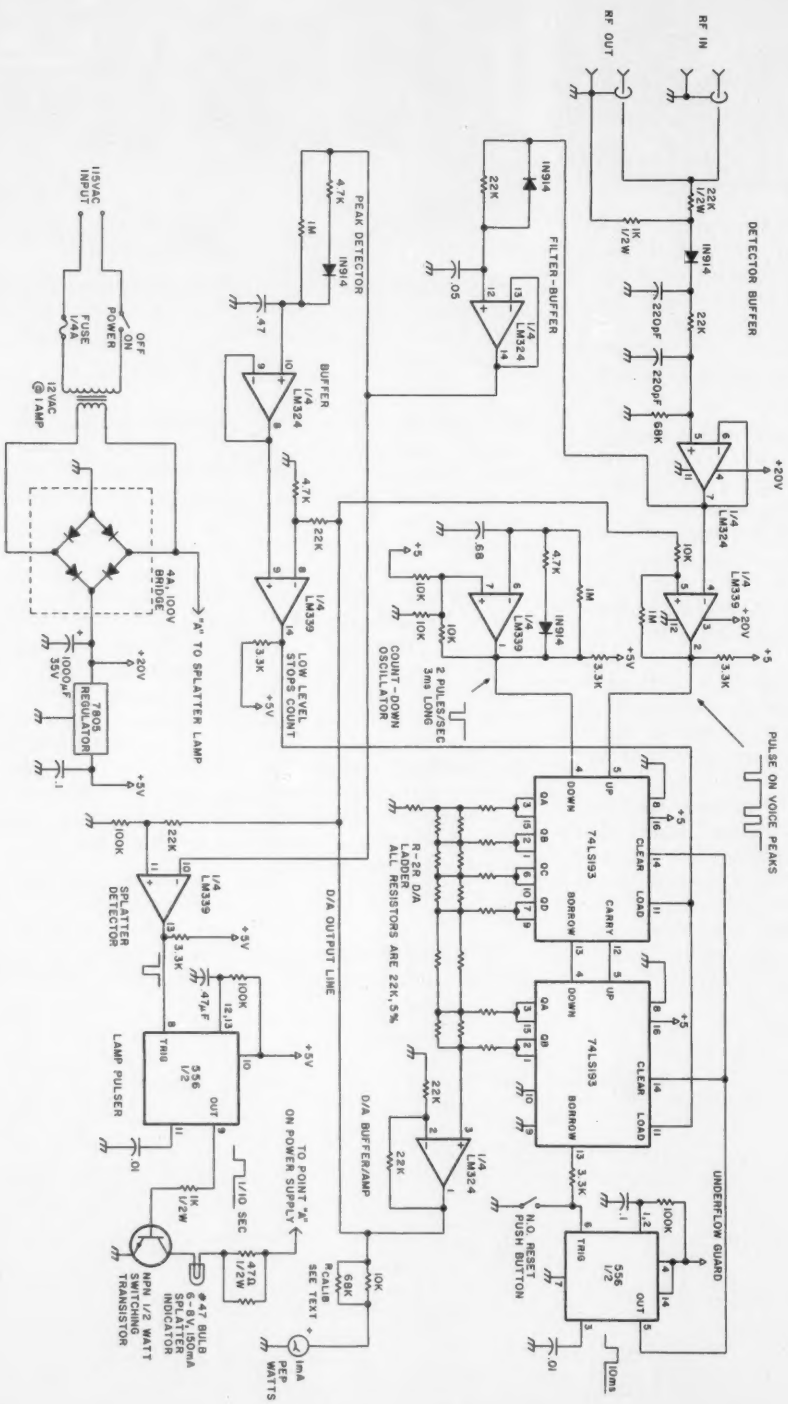

Fig. 2. Schematic diagram.

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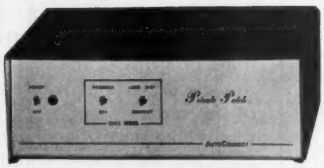

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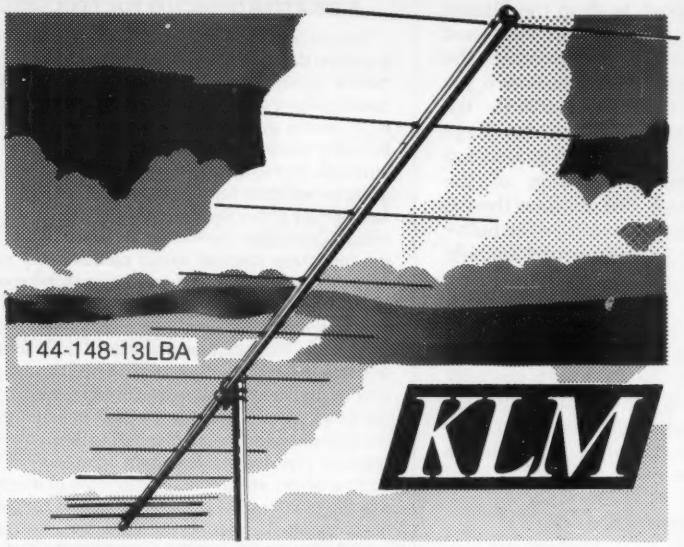

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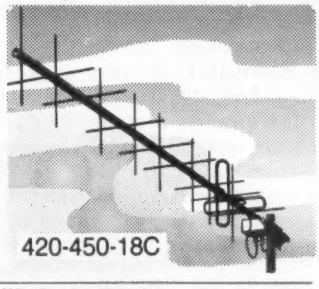

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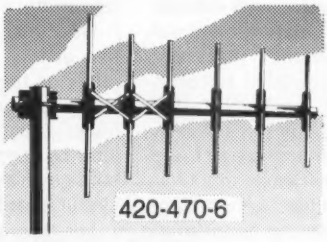

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the 20-volt supply, this is enough to drop the filtered dc level several volts and significantly increase the ripple. As an alternative, the bulb is powered from the half-wave rectified voltage present between ground and either input side of the bridge. The rms level there is a better match for the bulb's design voltage, and the bulb current has little impact on the 20-volt supply since it is isolated from the filter circuit. The two 47-Ohm resistors in series with the bulb limit the current so that the lamp brightness is about the same as when powered from a true 6-volt source.

Construction

As can be seen in the photographs, my unit makes liberal use of flea-market components. The parts list specifies equivalent Radio Shack parts which can be used to build a similar-looking unit. Total cost using all Radio Shack parts is around $65, but there are many corners which can be cut to reduce that price.

My flea-market cabinet is a real deluxe job, so the parts list specifies a correspondingly nice $9 unit. A similar-size Bud Minibox or other enclosure would work as well and cost much less.

The Radio Shack meter also costs $9, but many surplus outlets having advertisements in *73* regularly offer similar meters at less than half that price.

My junk box contained a salvaged plug-in-type circuit board and socket; those two items purchased new total almost $7. Obviously the plug-in feature is nice, but it is also completely unrelated to the electrical operation of the circuit.

Radio Shack components are of reasonable quality and readily available, so they are a good yardstick to use in measuring the maximum cost of this project. Remember, however, that with a little resourcefulness, the cash outlay can be substantially reduced.

Using Radio Shack component values is also sometimes difficult. The R-2R ladder in my unit is actually constructed with 10k and 20k resistors. The schematic and parts list specify 22k resistors because they were in the Radio Shack catalog, but using only that size requires paralleling 5 extra resistors to create the 11k values. Electrically that's perfectly acceptable, but physically it's somewhat bulky. If you do buy the 22k resistors, the entire project uses 23 of them. Since only 17 go in the ladder network, be sure to use the opportunity to select out the closest matched group of 17 with an ohmmeter.

You'll see in Photo B that I used a single rf connector while the schematic shows a two-connector loop-through. I run the transmission line right by the back of the instrument and use a tee connector to connect to the input of the Splattometer. The two-connector loop-through is preferable as it avoids completely the temptation to connect the instrument to the line with a single length of cable, cable which would look like a reactive stub on the higher bands and so interfere with transmitter tuning.

Note also that the resistive divider is mounted directly on the back of the input connector. That minimizes stray coupling problems by keeping the large rf voltage away from the main circuit board.

For the same reason, the rf detector and filter components are grouped by themselves in one corner of the main board. I mounted the ac fuse inside the box since the back panel opening on my cabinet wasn't large enough for the ac line, rf input connector, and fuse, too. The parts list specifies a panel-mounted fuseholder since most people won't have my space problem.

The simple power supply is built as a separate unit. Certainly that handful of parts could be placed on the main board with the rest of the circuit. The advantage of the separate approach is that is is easier to disconnect and test the power supply by itself. It's also convenient to be able to insert current meters between the supply and main circuit during checkout.

The front panel can be laid out in any desired manner. Try to choose a lamp holder which will easily be visible over a wide angle. One advantage of the flashing indicator is that it can attract attention without being constantly watched. Don't ruin that feature by using a lamp assembly which has a narrow viewing angle. I didn't include a power-on indicator lamp on the assumption that it might lessen the visual impact of the splatter indicator.

The PEP wattmeter is actually a dc voltmeter reading 0 to 8.5 volts, so any dc current instrument with a full-scale range of 5 mA or less will work with a suitable selection of series resistor. The rf sampler and filter circuits of the Splattometer are designed so that a 3-volt dc output at the D/A converter corresponds to 100 Watts PEP delivered to a 52-Ohm load. Power is proportional to voltage squared and the D/A output can range from almost zero to 7.5 volts, so the meter will read from near zero to about 700 Watts PEP. Meter calibration is quick and easy using the calibration chart shown in Fig. 3.

I made a whole new face for my junk-box meter using India ink, press-on transfers, and a piece of good writing paper pasted to the *back* of the old metal meter face. The back of the metal plate

A SPLATTER DETECTOR FOR PROCESSED AUDIO?

Several people have independently suggested how to build a splatter detector which might work with both processed and natural audio. The suggested technique is certainly worth passing along as a guide to further experimentation. The idea is to identify the sharp clipped corners which cause splatter by doing some frequency analysis on the AM-detected SSB envelope. In this approach, the output of a lightly filtered AM detector would be separated into two channels—one each for frequencies above and below 3 kHz. Ideally, the signal filtered into the low-pass channel would be all "good" energy while the high-pass channel would contain only splatter signal. These two audio channels could then themselves be rectified, filtered, and compared in magnitude to provide some measure of the amount of splatter at any given time.

I see two main problems with this approach, one practical and one theoretical. First, the low-pass and high-pass filters may be difficult to design in an easily reproduced form. There will be a lot of signal in the low-pass channel, but not much in the high-pass section: perhaps 30 to 50 dB of rejection will be required over a small (less than an octave) frequency range. Each channel will probably need three or more cascaded active filters with closely matched cut-off frequencies, Q, and passband ripple. Second, the high-pass channel will also contain signals not caused by splatter—the 3rd and 5th order distortion products—and these signals may confuse the splatter-detection process. Their presence certainly adds an interesting element to the trade-off between time and frequency domain analysis. The detection approach outlined in Fig. 1 has a lot of positive features: it works fine with unprocessed audio, is auto-adaptive over a wide range of input levels, is easily reproduced, and is low in cost. The processed audio problem is ripe for experimentation and perhaps some readers would like to give it a try.

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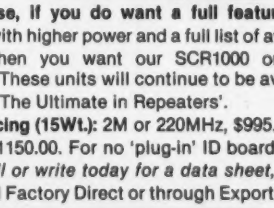

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50	2.12	.25
100	3.00	.353
150	3.67	.432
200	4.24	.50
300	5.20	.612
400	6.00	.707
500	6.71	.79
600	7.35	.866
700	7.94	.935
800	8.49	1.00

Fig. 3. Meter calibration points.

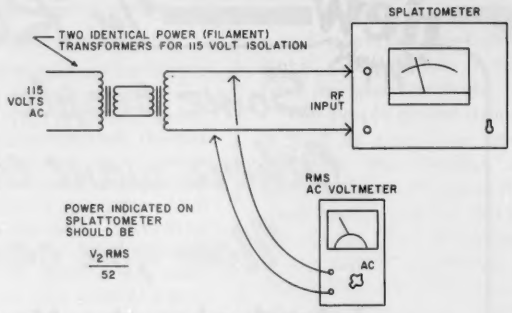

Fig. 4. Calibration using the 115-V, 60-Hz line.

is blank, of course; the original scale would show through paper glued to the front of the faceplate. To make the scale, draw an arc on the new meter face, replace the faceplate and connect the meter to a variable power supply through a resistor sized to make 8.5 volts read full scale. With a 1-mA meter, that resistor should be just under 8.5k. The schematic shows a 10k resistor in parallel with a higher value; 56k will do the job almost exactly. If you purchased the Radio Shack resistors, there will be a spare 68k, ¼-Watt resistor which will work fine.

With the chosen resistors in place, set the supply to 8.5 volts and mark that pointer position as 800 Watts. Now go down through the middle column of Fig. 3 marking the wattage levels at the corresponding voltage points. Finish up by removing the faceplate and adding the dry transfer numbers at the appropriate spots. If you don't want to go through the trouble of making a new meter face, the third column of Fig. 3 can be used to make a conversion chart for the existing scale on a 1-mA instrument.

For convenience, I built the main circuit on a plug-in prototype card. This board comes drilled with .1-inch spaced holes and has an array of printed circuit pads etched on one side. The IC sockets and passive components are mounted on the front of the board and the interconnections are made from the rear with short lengths of wire. Wire-wrap wire is nice to use for the wiring because of its small size. The finished board doesn't look as nice as a real printed circuit card, but it is quicker to make, works as well, and is easier to modify should a reason arise. If you wish, you can save some money by skipping the plug-in feature and hard-wiring the necessary external connections to a standard prototype board.

Checkout and Operation

There is nothing critical about this circuit that has to be "tweaked" in to allow proper operation. If the project doesn't work when first turned on, the reason is most likely a wiring error or sloppy soldering, so check your work carefully. It is always prudent to try the power supply first, making sure the proper operating voltages are there. With everything connected, the meter will probably read upscale when the power is switched on. This is because the counter stages turn on in some random condition. Pushing the reset button should drop the meter pointer almost to zero.

Connect a transmitter through the unit to a dummy load and tune up for normal SSB operation. To maintain calibration accuracy, the Splattometer should always be inserted in the line at a low swr position, that is, between the transmitter and antenna coupler if one is used. Push the reset button after tuning up, key the transmitter, and say a few words into the microphone. The splatter lamp will flash on the first few syllables and the meter will move rapidly upscale. The Splattometer has now calibrated itself to your transmitter's PEP output and is watching for flattopping. The meter will flicker only slightly as you continue to talk; between words and transmissions it will hold dead still. The typical efficiency of a linear amplifier is around 60%, so if the transmitter is rated at 200 Watts PEP input, the meter should indicate about 120 PEP Watts output.

Now turn up the microphone gain, talk more loudly, or cluck into the microphone. The splatter lamp will flash but the PEP output meter won't move upward any more than when you were talking normally. If you have an swr bridge or averaging power meter in the line, you'll notice that it *does* indicate more power when you flattop. A lot of amateurs make themselves unpopular because they don't realize some of that "extra" power is just splatter.

Incidentally, during CW operation the splatter lamp will flash on every key closure since the CW signal is detected as a severely distorted SSB signal!

One limitation of the Splattometer circuit is that it may not respond properly when speech processing is used. This failure results from assuming that splatter is always associated with an extended period of maximum transmitter output. The splatter isn't *generated* during the clipped interval, however; it's really a result of the sharp transition between the flattop level and the rising (or falling) envelope power at the beginning (or end) of the clipped peak. Key clicks on a poorly-shaped CW signal are caused in exactly the same manner. When normal unprocessed audio is used to generate the SSB signal, any peak clipping would be expected only in the output amplifier, so in that case splatter and limiting go together and the Splattometer will work beautifully.

With processed audio, the situation is different. Speech processors, whether designed to work at audio or rf, generally contain somewhere in their makeup a compression amplifier, clipper, and filter. The amplifier brings up the relative amplitude of the weaker voice sounds, the clipper limits the peak output level, and the filter removes the high-frequency distortion products caused by the clipping action. The SSB envelope produced with processed audio can have flattened peaks holding at the maximum output level for relatively long periods of time. Such peaks do not in this case indicate the existence of splatter because the clip-

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ping occurs in the speech processor (where it is also "cleaned up" with a filter) and not the transmitter's final amplifier. The Splattometer will detect these peaks and incorrectly indicate the signal is splattering.

This shortcoming is really not the handicap it first appears to be. Once the clipping level in the processor is correctly set, that circuit will prevent the transmitter output stage from being overdriven into saturation —no matter what happens at the microphone. Increased audio input to the processor or increased amounts of compression will raise the average output power (and the amount of distortion in the audio recovered at the distant receiver), but the *peak* input to the final amplifier will be safely limited by the processor's clipper and splatter will not occur. The Splattometer is needed most in the situation where it works best: an SSB transmitter running with unprocessed audio. In that case, clipping is most likely to occur in the transmitter's output stage. Such clipping will cause splatter and the Splattometer will correctly identify the condition.

PARTS LIST

Item		Number Needed	Radio Shack Part Number	Quantity per pack
Resistors				
47 Ohms,	½ W	2	271-009	2
1k	½ W	2	271-023	2
22k	½ W	1	271-038	2
3.3k	¼ W	5	271-1341	5
4.7k	¼ W	3	271-1330	5
22k	¼ W	23	271-1339	5
10k	¼ W	5	271-1335	5
100k	¼ W	3	271-1347	5
1 Meg	¼ W	3	271-1356	5
68k	¼ W	1	271-1345	5
Capacitors				
1000 uF,	35 V	1	272-1019	1
220 pF		2	272-124	2
.01 uF		2	272-131	2
.1 uF		2	272-135	2
.47 uF		2	272-1417	1
.68 uF		1	272-1418	1
.05 uF		1	272-134	2
Semiconductors				
1N914		4	276-1122	10
4 A, 100 V bridge		1	276-1171	1
7805 regulator		1	276-1770	1
NPN transistor		1	276-2030	1
LM324 quad amp		1	276-1711	1
LM339 comparator		1	276-1712	1
74LS193 counter		2	276-1936	1
556 dual timer		1	276-1728	1
Miscellaneous Electrical				
1-mA meter		1	270-1752	1
12-V transformer		1	273-1505	1
#47 lamp		1	272-1110	2
¼-Amp fuse		1	270-1270	3
Hardware				
Power switch		1	275-602	1
Reset switch		1	275-609	2
Fuse holder		1	270-364	1
Lamp socket		1	272-325	2
Rf connector		2	278-201	1
Cabinet		1	270-269	1
Plug-in board		1	276-153	1
Board socket		1	276-1551	1
Circuit board (for power supply)		1	276-158	1
16-pin sockets		2	276-1998	2
14-pin sockets		3	276-1999	2

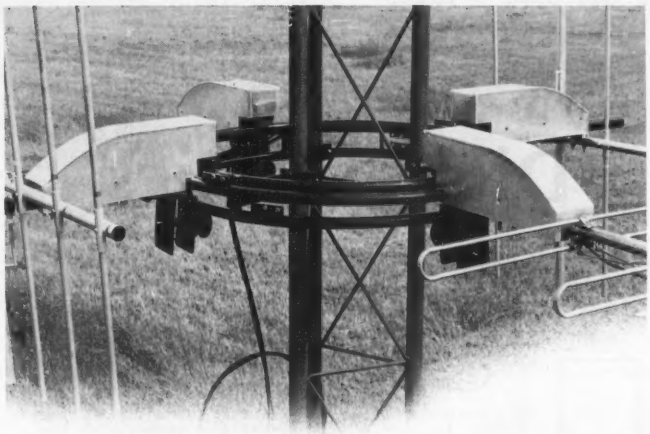
The final wattmeter accuracy is dependent on several things but should be within 10 or 15 percent without further adjustment. If you're really finicky about such things, it can be set on the nose with an isolated 60-Hz source and a good ac voltmeter. Use a 1:1 isolation transformer or two filament transformers back-to-back as shown in Fig. 4 and feed the output into the Splattometer. Measure the equivalent input power as the square of the rms voltage divided by 52. If necessary, the series meter resistor can be adjusted so that the pointer exactly indicates the calculated power.

Wattmeter accuracy is also dependent on swr. Remember that the wattmeter is really a peak-reading rf voltmeter which can be calibrated in Watts only because the load is specified as 52 Ohms and $P=E^2/R$. The wattmeter scale will be inaccurate if another load impedance is used; for example, if the load is doubled to 104 Ohms, the indicated power will be twice the actual power. If the transmission line swr isn't 1:1, the problem is harder to solve since the wattmeter readings will vary with the electrical length of the line. The rf voltage on a line having 2:1 swr will vary over a 2 to 1 range depending on line length. The indicated power, if based only on the voltage measurement, would vary over a 4 to 1 range—from about half to twice the actual power! The Splattometer's PEP wattmeter can be calibrated and used as a worthwhile test instrument, but don't forget to consider errors caused by swr. The splatter-detection portion of the instrument will of course be unaffected by swr as long as the wattmeter reading settles out to something between 25 and 700 Watts.

The resistor values at the input rf voltage sampler can be changed to shift the Splattometer operating range if desired. Reducing the 1k resistor to 510 Ohms almost doubles the input voltage necessary to create a specific meter reading, so the instrument will then read from about 100 to 3000 Watts. For low-power operation, the 22k input resistor can be reduced to 9.1k and the resulting range will be approximately 4 to 120 Watts PEP.

During normal SSB operation, the splatter lamp should flash only occasionally, maybe once or twice per sentence. Any more than that is too much and calls for a reduction in microphone gain.

Nobody wants to overdrive his transmitter and cause splatter, but the desire to get maximum output power is a strong one. Until now, the preferred monitoring technique required an oscilloscope. That solution is bulky, expensive, and requires constant attention in a dim room. The Splattometer is a much better alternative: It's inexpensive, unobtrusive, and, unlike the complex oscilloscope display, tells you only what you want to know exactly when you need to know it. You'll certainly find it a worthwhile addition to your equipment if you operate much SSB. Even if you're primarily a CW operator, it might make an excellent Christmas present for that SSB operator down the block! ■



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Digital Basics
—part II

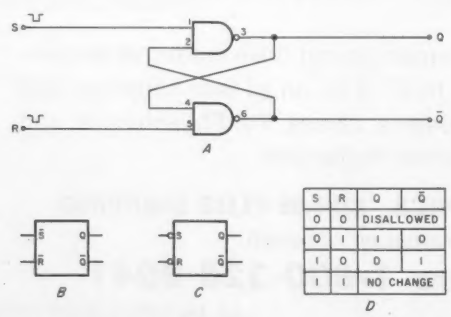
In part I of this series, I introduced you to the principal IC logic families and the various different forms of logic gates. Here in part II, we will continue our study of basic digital electronics by investigating *flip-flops.*

Flip-Flops

All of the digital circuits discussed thus far have operated in a "transient" manner. Gates and inverters do not have any *memory*, so once the input condition changes, then the output state that results from those conditions also is likely to change.

A flip-flop (FF) is a circuit that is capable of *storing a single bit* (i.e., a binary digit, either 1 or 0) of digital data; it will remember an input condition and hold the same output after the data has passed. There are various different types of flip-flop circuits, and they all operate on slightly different (even though similar) sets of rules. But one thing that they all have in common is the ability to store a single data bit.

All common forms of flip-flops can be made from various combinations of the basic AND, OR, NAND, NOT, NOR, and XOR gates. The NAND, NOR, and NOT gates are particularly often used to make flip-flops. Except for the two simplest flip-flops presented here in part II, most electronic circuits use IC flip-flops instead of actual IC gates. It is simply too costly to *make* flip-flops from IC gates when the same manufacturers do all of the interconnections for you by offering the various flip-flops pre-made in IC form.



S	R	Q	$\overline{Q}$
0	0	DISALLOWED	
0	1	1	0
1	0	0	1
1	1	NO CHANGE	

D

Fig. 1. (a) A reset-set flip-flop (RS FF) can be made from two NAND gates. (b) Symbol for RS flip-flop. (c) The circled inputs for R and S indicate that these inputs are active-LOW. (d) The operation of an RS flip-flop is summarized in this truth table.

Reset-Set (RS) Flip-Flops

One of the simplest forms of flip-flop circuit is the *reset-set*, or *RS*, flip-flop. (Some textbooks, especially those over ten years old, call it a set-reset, or SR, flip-flop.) The RS flip-flop can be made from either two NAND gates or two NOR gates, although note that operation of the two versions is slightly different.

Fig. 1(a) shows the circuit for an RS flip-flop made from a pair of NAND gates, such as the TTL 7400 device (which contains four two-input NAND gate sections).

There are two inputs required on the RS flip-flop, *set* and *reset*. Usually there are also two output terminals, and these are complementary: Q and NOT-Q ($\overline{Q}$). *Complementary* means that one will be LOW if the other is HIGH. For example, when the Q output is HIGH, then the NOT-Q will be LOW. When the Q output is LOW, then the NOT-Q will be HIGH.

The inputs of the NAND version of the RS flip-flop are active-LOW so are sometimes designated $\overline{S}$ (NOT-S) and $\overline{R}$ (NOT-R). Whenever you see an *input* that is designated as a NOT-input, has a bar over its symbol, or that has a circle in the schematic diagram, then we know that it is an active-LOW input terminal. The circuit action of an active-LOW input occurs when the terminal is brought LOW. An example of a schematic that uses the circled inputs is shown in Fig. 1(c), while the normal symbol for the RS flip-flop is shown in Fig. 1(b).

A momentary LOW on the *set* input of the NAND gate RS flip-flop causes the outputs to go to the state where the Q is HIGH and the NOT-Q is LOW. Note that the term *set* usually means Q = HIGH and NOT-Q = LOW, while *reset* indicates just the opposite: Q = LOW and NOT-Q = HIGH. The flip-flop is said to possess *memory* (and, indeed, solid-state computer memory uses arrays of FFs), so the outputs will stay in the set condition unless a *reset* pulse is applied to the *R* input.

The reset function is obtained by momentarily bringing the reset input LOW. This forces the outputs to go to a state in which the Q is LOW and the NOT-Q is HIGH.

The rules for the operation of the NAND-logic RS flip-flop are summarized in the truth table shown in Fig. 1(d). This truth table also lists two additional conditions besides those discussed above. One of these is the condition in which both set and reset inputs are brought LOW simultaneously. This is a *disallowed* state, and the circuit will not know what to do; the output state will be unpredictable.

The other condition is the case where both inputs are simultaneously HIGH. In this condition we find that there is no change in the output state. The RS flip-flop simply remains in the condition present when the inputs were made HIGH.

A NOR-logic version of the RS flip-flop is shown in Fig. 2. This circuit may be constructed from TTL/7402 NOR gates. Like the 7400 device, the 7402 contains four independent two-input gates (in this case, the NOR variety). The circuit in Fig. 2 performs differently from the NAND-logic version of Fig. 1, but there are similarities even though a slightly different set of operating rules prevails.

The rules governing the NOR-logic RS flip-flop are summarized in the truth table of Fig. 2(c), but let's go over them briefly:

1) If *both* inputs are LOW, then there is no change in the output state.

2) If *both* inputs are simultaneously HIGH, then we have a disallowed state and the output condition is unpredictable.

3) If the *set* input is made HIGH momentarily, then the output condition is Q=HIGH and NOT-Q=LOW.

4) If the *reset* input is made HIGH momentarily, then the output condition is Q=LOW and NOT-Q=HIGH.

Note again the principal difference between the two forms of RS flip-flop (examine the truth tables in Figs. 1 and 2 again). The NAND-logic RS flip-flop has *active-LOW* inputs, while the NOR-logic RS flip-flop has *active-HIGH* inputs.

Clocked RS Flip-Flops

We sometimes get into trouble with flip-flops that are too simple. We see, for example, electronic versions of the old *relay-race* problem. In that problem and its modern electronic version with digital circuits, two relays may have slightly different actuation times. If the time difference is such that they operate out of the intended order, then catastrophic results sometimes occur. Many of these problems are solved in the digital electronics world by using *clocked,* or *synchronous*, operation. In the case of the RS flip-flop, we obtain clocked operation by using the *master-slave flip-flop*, also called the *clocked RS flip-flop.*

The purpose of the *clock* (a train of pulses) is to synchronize the changes in the output condition by allowing them to occur only at certain times during, or immediately following, a clock pulse. Most large-scale digital circuits will use synchronous operation in order to keep things straight.

There are two basic forms of clocking used in RS flip-flops: *level-triggered* and *edge-triggered.*

A level-triggered flip-flop is one in which the output state changes in response to conditions on the inputs only when the clock input is either HIGH or LOW (depending upon the type). Some level-triggered circuits require the clock pulse to be LOW for it to be active, while others (the more usual case) require the clock pulse to be HIGH.

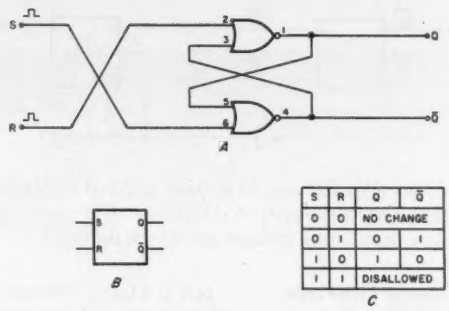


Fig. 2. (a) An RS flip-flop can be made from NOR gates as well as NAND gates. (b) The RS flip-flop built from NOR gates has active-HIGH S and R inputs. (c) A NOR-logic RS flip-flop follows this truth table.

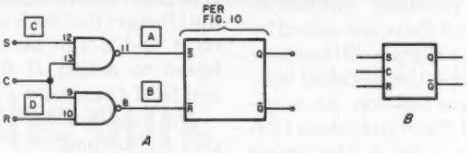


Fig. 3. (a) By adding two NAND gates to a NAND-logic RS flip-flop, a level-triggered clocked RS flip-flop is obtained. (b) Schematic symbol for a level-triggered clocked RS flip-flop.

An edge-triggered flip-flop will allow state changes only during one of the two transitions of the clock pulse. The pulse must be in the process of going from LOW to HIGH, or from HIGH to LOW (again, depending upon type). A positive edge-triggered flip-flop, therefore, will allow output changes to occur only on the positive-going transition (LOW to HIGH) of the clock pulse. A negative edge-triggered flip-flop allows output transitions only on the negative-going (HIGH to LOW) transition of the clock pulse.

It is important to remember the difference between these two types of triggering, so let's reiterate: *Level triggering* means that changes can take place only during the time when the clock pulse is active, i.e., either HIGH (positive level-triggered) or LOW (negative level-triggered); *edge triggering* means that output changes can take place only during the transition period of the clock pulse. A positive edge-triggered FF changes only on the LOW to HIGH transition, while a negative edge-triggered FF wants to see the negative-going, or HIGH to LOW, transition.

An example of a simple level-triggered clocked RS flip-flop is shown in Fig. 3. The main flip-flop is the same as the circuit in Fig. 1, so it is shown here in block form for the sake of simplicity. The *S* and *R* inputs are controlled by a pair of NAND gates. When the clock pulse is LOW, then both inputs of the RS flip-flop section (i.e., points A and B) see a HIGH, so no change can take place.

But, when the clock input goes HIGH, the levels at points A and B (i.e., the *S* and *R* inputs of the FF section) are then controlled by the other inputs of the NAND gates. These inputs are used as the *S* and *R* inputs of the clocked FF. If you doubt this, then review the operation of the NAND gates.

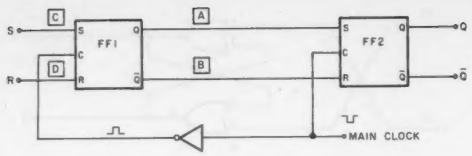


Fig. 4. Two RS flip-flops in a back-to-front configuration constitute a master-slave (M-S) flip-flop. This circuit allows only one output state change per clock pulse.

Master-Slave Flip-Flops

The use of clocking helps a great deal in taming the RS flip-flop, but several problems, again electronic versions of the old relay-race problem, still occur. Most of these are solved by using a slightly different approach—the so-called *master-slave flip-flop*. An example of the master-slave FF is shown in Fig. 4. This circuit allows only one output state change per clock pulse (the clocked RS FF allows continuous output state changes as long as the clock input is active).

The M-S flip-flop of Fig. 4 uses the clocked RS flip-flops of the previous example connected in cascade. The inverter shown allows us to drive the clock inputs of the two clocked RS FFs out of phase with each other.

Recall that the clocked RS flip-flop can change its output state only when the clock input is HIGH, and then only in response to conditions on the R and S inputs. In the M-S FF, the main clock is kept HIGH, so FF2 is active and FF1 is inactive.

When a clock pulse is applied (in this case a negative transition), FF1 will become active, and FF2 becomes inactive. Note that the effect of the inverter is to make the clock input of FF1 HIGH at this time. Any commands placed on the S and *R* inputs will cause changes in the outputs of FF1 (i.e., points A and B in Fig. 4).

But, because FF2 is inactive at this time (its clock input is LOW), changes at A and B are not yet reflected at the Q and NOT-Q outputs of FF2. But, once the master clock goes HIGH again, the clock input of FF2 goes HIGH again, so the changes that took place on A and B can be transferred to action at the Q and NOT-Q outputs.

The synchronization occurs by keeping FF2 inactive when the input stage (FF1) is being set up, and then rendering FF1 inactive (forbidding further *S* and *R* input changes from affecting the output), while transferring the data to FF2. This part of the sequence is called a *load-transfer operation.*

Additional Types of Flip-Flops

Thus far we have considered two versions of the RS flip-flop (NAND logic and NOR logic) and two flip-flops that are derivatives of the RS circuits, the clocked RS flip-flop and the master-slave flip-flop. In the sections to follow, we will consider some more complex types of flip-flop: *type-T* FF, *J-K* FF, and the *type-D* FF.

Type-T Flip-Flops

The type-T flip-flop (also called the *toggle FF*) is shown in Fig. 5. This FF circuit can be constructed by providing feedback connections (as shown) around an ordinary master-slave flip-flop. Recall that the M-S FF was constructed from a pair of RS FFs and an inverter stage. Note that the Q output is fed back to the reset input and the NOT-Q output is fed back to the set input.

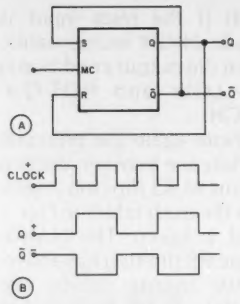


Fig. 5. (a) A type-T, or toggle, flip-flop is obtained by adding feedback connections to a master-slave flip-flop. This circuit acts as a binary divider. (b) For a toggle flip-flop, a negative-going transition of the clock results in a change of the output (Q) status.

The type-T flip-flop functions as a binary divider; that is, the output signal has a frequency that is one half (i.e., divided by 2) of the input signal. The timing diagram for this circuit is shown in Fig. 5(b). Note that the Q output changes state only on negative-going transitions of the clock pulse. At the first negative transition, the Q output will snap HIGH and remain HIGH until the clock input sees *another* negative transition. This condition occurs at pulse number 2, at which time the Q output goes LOW again. We have, therefore, binary division of the input frequency: One output pulse is produced for each *two* input pulses.

There sometimes are found differences in terminal designations from one text or spec sheet to another. In Fig. 5(a), for example, we have labeled the clock input *MC* for main clock. But it is likely that you also will see T for toggle, or C_P for clock.

J-K Flip-Flops

One of the most useful and perhaps most common forms of clocked FFs is the J-K flip-flop. There are several advantages to the typical J-K flip-flop. (a) There are no invalid or disallowed states in the clocked mode. (b) It can cause the outputs to complement. And (c), it can provide non-clocked operation (in some IC versions).

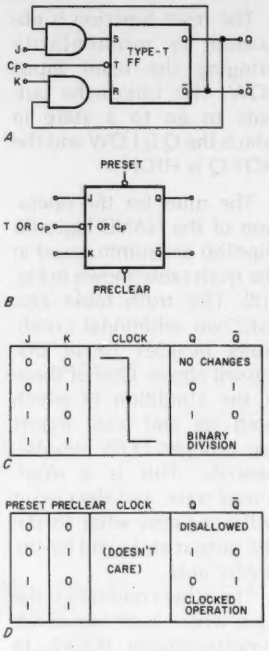
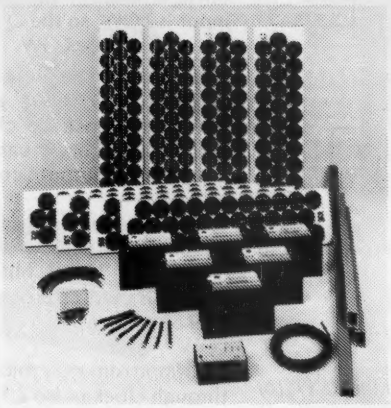
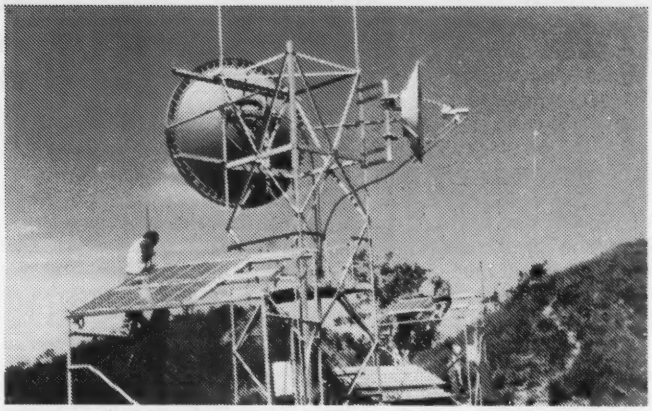


Fig. 6. (a) Two AND gates and a type-T flip-flop combine to form a J-K flip-flop. (b) Several designations (MC, T, or Cp) are used to indicate the clock input for a J-K flip-flop. (c) When both the preset and preclear inputs are HIGH, a J-K flip-flop is in the clocked mode. The output depends on the status of the J and K inputs. (d) Direct control of the J-K flip-flop is accomplished by using the preset and preclear inputs.

Fig. 6 shows one of several popular ways to represent the J-K FF. In this case, we see that it is a type-T FF with feedback to the set and reset inputs controlled by a pair of two-input AND gates. One input from each gate accepts the feedback lines, while the remaining inputs of the gates are used to form the *J* and *K* inputs of the FF, respectively.

Fig. 6(b) shows the circuit symbol for a J-K flip-flop.





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Not all versions of the J-K will have the direct-mode inputs (preset and clear). These inputs do, however, make it a more useful device. The *preset* input may also be called a *direct-set* input, and the *preclear* input called a *direct-clear* input.

Direct mode operation. The operation of the J-K flip-flop in the direct mode is very simple, and it is independent of conditions applied to the J and K inputs. The direct mode is controlled only by conditions on the *preset* and *preclear* input terminals, and the rules are summarized in Fig. 6(d).

The direct mode inputs are active when LOW, so the only disallowed state occurs when both are simultaneously LOW.

If the preset input is LOW and the preclear input is HIGH, then the outputs immediately go to a condition where Q is HIGH and NOT-Q is LOW.

If the preclear input is made LOW and the preset input is HIGH, then the outputs go to a state where Q is LOW and NOT-Q is HIGH.

It is a general rule, when dealing with flip-flops of any type, that set or preset operations make the Q output HIGH and the NOT-Q output LOW, while clear and reset operations work in just the opposite manner (i.e., Q LOW and NOT-Q HIGH).

If both preset and preclear inputs are made HIGH, then the flip-flop is ready for normal clocked operation.

Clocked operation. Whenever the preset and preclear inputs (where used) are simultaneously HIGH, the J-K will operate in the clocked mode. The rules for clocked operation are summarized in Fig. 6(c).

Like the type-T FF, the J-K FF (in the clocked mode) responds on the negative-going transition of the clock pulse. No output changes will occur regardless of changes at the *J* and *K* inputs, until one of these negative-going clock pulse transitions is seen. The outputs will then respond according to the J-K input conditions. The rules for clocked operation are as follows:

1). If both J and K are LOW, then the FF is inert and does nothing. No changes will occur in the outputs.

2) If J is LOW and K is HIGH, then the clocking will make Q LOW and NOT-Q HIGH.

3) If J is HIGH and K is LOW, then the clock pulse transition makes Q HIGH and NOT-Q LOW.

4) If both J and K are HIGH, then the J-K FF behaves much like a type-T FF; clocking complements the outputs. This means that negative-going clock-pulse transitions force the outputs to go to the opposite state. The output waveform of the J-K flip-flop is then identical to the output waveform of the type-T flip-flop given in Fig. 5.

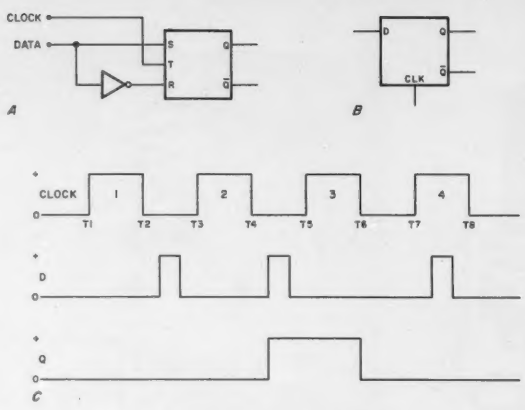

Fig. 7. (a) The type-D flip-flop is a derivation of the RS FF. (b) Symbol for a type-D flip-flop. (c) Data appearing on the D input is transferred to the Q output only when the clock line is HIGH.

Type-D Flip-Flop

The type-D or *latch* flip-flop is shown in Fig. 7. The equivalent circuit is shown in Fig. 7(a), while the usual schematic symbol is shown in Fig. 7(b).

The equivalent circuit consists of a clocked RS FF in which the set and reset inputs are fed by the same signal but are 180 degrees out of phase with each other (i.e., complementary inputs). An inverter between the *S* and *R* lines accomplishes this neat trick.

The common line to the reset-set-inverter is called the *data* or *D* input instead of clock. This input is usually labeled D on most schematics.

The rule for operation of the type-D FF is very simple: Data appearing on the D input will be transferred to the Q output only when the *clock* line is HIGH.

1) If the clock line is HIGH, then the output will *follow* changes in the input signal (i.e., changes on the *D* input). When the D line goes HIGH, then the output will go HIGH. Similarly, when the D line goes LOW, then the outputs follow by also going LOW.

2) If the clock line is LOW, then the output will retain the last data that existed on the D input at the instant the clock line dropped LOW.

These rules can also be seen in the timing diagram of Fig. 7(c). Read the description below, keeping in mind the two rules just given.

a) When the first clock pulse arrives (T1-T2), the D input is LOW, so the Q output also will be LOW.

b) During the interval T2-T3, the D input goes HIGH, but since no clock pulse is present, it cannot affect the output conditions.

c) At the beginning of interval T3-T4, clock pulse number 2 is HIGH, but the D input is LOW. The output, therefore, must remain LOW.

d)Approximately midway through clock pulse 2, however, the D input goes HIGH, forcing the Q output to also go HIGH.

e) The Q output stays HIGH even after clock pulse 2 goes LOW.

f) At the onset of clock pulse number 3, the D input is LOW, so the Q output drops LOW also.

g) The pulse on the D input during the interval T6-T7 cannot affect the Q output because the clock is LOW.

The so-called *data latch* device is a special case of the type-D flip-flop. This device is used in digital-readout circuits (e.g., in frequency counters) to hold current data until the new data has been updated and is ready for display. This gives the illusion that the data is updated instantaneously. In most cases, the clock input is called a *strobe* input. Data at the D input will be transferred to the Q output only when the strobe line is HIGH. The idea is to bring the strobe line momentarily HIGH when the data at the input is valid, and then let the strobe line go LOW again until the next newest data is ready.

And Now...

The third and final part of this series, to be published next, will allow you to wade into digital electronics up past your knees. The topics will be the most common multivibrator and counter circuits.■

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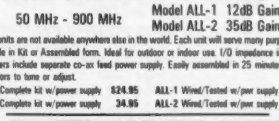

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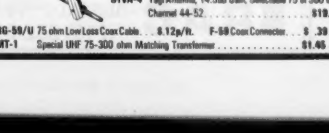

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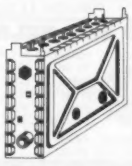

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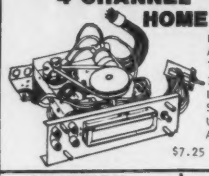

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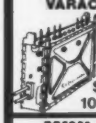

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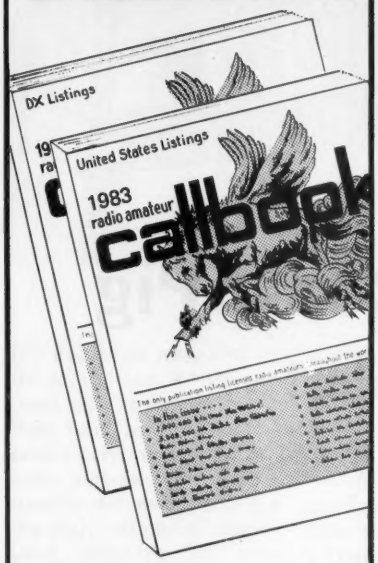

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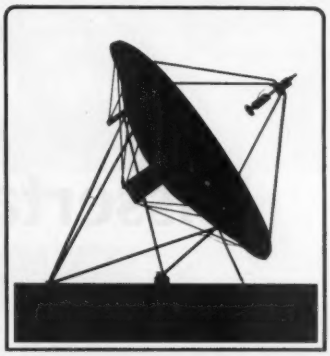

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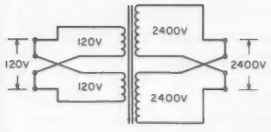

Fig. 1. 120-to-2400-volt connection.

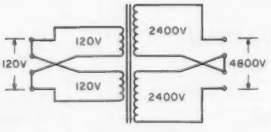

Fig. 2. 120-to-4800-volt connection.

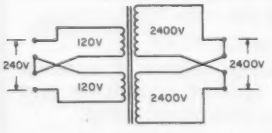

Fig. 3. 240-to-2400-volt connection.

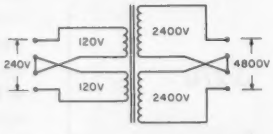

Fig. 4. 240-to-4800-volt connection.

This article is called "Dissertation Upon Roast Pig," with apologies to Charles Lamb, author of the essay with the same title. The poem was learned in high school literature class back in 1933, one year before I obtained my first amateur radio license (W9RTS). As you may remember, this was a comical poem which supposedly gave the origin of the succulent dish, roast pig. With regard to ham radio, roast pig refers to a much used, or roasted, transformer commonly known in amateur circles as "the pole pig." The dissertation is intended to bring a tear of joy to the eye of the old-timer, to acquaint the newcomer with the meaning of the term "pole pig," and to provide some technical know-how with regard to its use. Maybe some humor will creep in as well. First of all, what is a pole pig? Photo A shows a group of four. It is a distribution transformer which has for all intents and purposes served its useful

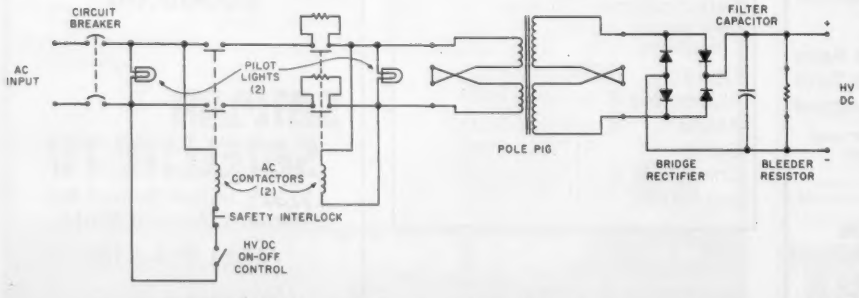

Fig. 5. Schematic of power supply with step-start control.

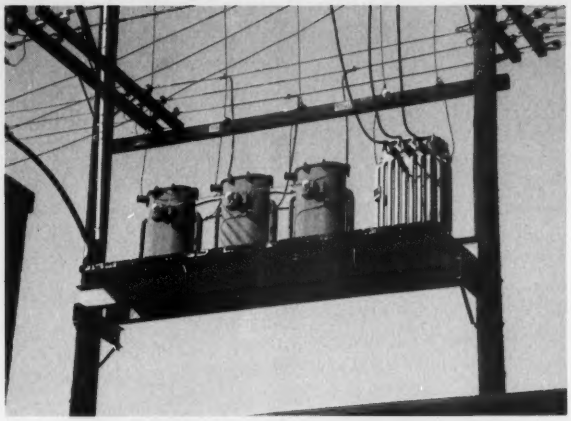

Photo A. A group of four pole pigs.

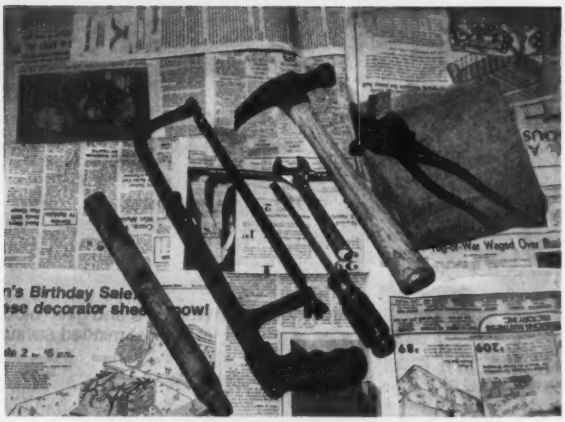

Photo B. Tools needed to procure a pole pig.

life and been relegated to the scrap heap. It has been used, or "roasted," for a long time by the electric power company for its primary purpose, that is, as a transformer which reduces the high voltage, as distributed, down to 120 volts each side of neutral for domestic use.

The term "pole" is taken from the fact that these transformers are usually mounted on a pole. The term "pig" is derived from the fact that, as amateurs are able to get them, they are unusually dirty and messy. They are completely saturated with transformer oil and have seen considerable use in power company service. They come in various sizes: 1, 3, 5, 25 kVA and larger. You will seldom see them larger than 50 or 100 kVA in your neighborhood. Of course, any transformer larger than 5 kVA is of no interest to us anyway.

Hams of long ago, and some to this day, used pole pigs to serve as the plate transformers in power supplies for their transmitters. The main reason that hams used them was the fact that they were cheap. About ten to fifteen years ago, they were available at electric company salvage yards for about $2.50 per kVA. They were, of course, used, but by judicious selection you could obtain a nice transformer for your plate supply.

In order to get a pole pig, supply yourself with a set of tools such as those shown in Photo B. Then go down to the electric power company salvage yard, identify yourself, and start off. Incidentally, I am told it is not so easy to do this as in times past. Well, anyway, meander around the yard, searching for the transformer of your choice. Photo C is typical of what you might expect to see. When you find one, give it the nose test. Smell it to make sure it is not burned out. A clever nose will find it easy to determine when a transformer is burned out. After making a choice, ask the yard attendant to drain the oil. Sometimes they are already drained, because the power company cleans and reuses the oil. After draining the oil, take hacksaw and cutting pliers and cut the leads going to the external terminals of the case. Following this, take the hammer and, with an old screwdriver serving as a chisel, remove the wooden wedges holding the transformer in the case. Then remove it from the case. If you are lucky, the yard attendant will help you do this, using a forklift, and then deposit the transformer into your car trunk or trailer. Incidentally, have plenty of rags and paper upon which to place it, since these transformers keep on weeping oil for months after acquisition. After you get it home, don't do anything to it for about six months except store it in a corner on a stack of newspapers to absorb the oil. This oil was used to cool and insulate these transformers in normal service, but is not required for intermittent amateur service.

Photo C. Possible candidates.

Now, having obtained a pole pig, and after allowing most of the oil to drain, let's see what it requires to put one into service. The next two photos show what was done with a 5-kVA, 4800-volt-to-240-volt unit.

Photo D is a front view with the high-voltage terminals toward you. Note that they are encased in red fiber tubing. These tubes have been cut down from their original length, since these terminals would stick up too high otherwise. Photo E shows the 240-volt terminals toward you. Note the larger solder lugs and also that the two center terminals are connected together, on both high and low voltage windings. More about the connections later. You may observe that this transformer is quite neat and has risen above the looks of the average pole pig. But then, let's use it.

Photo F shows a completed power supply assembled into a 22-inch by 30-inch by 40-inch roll-

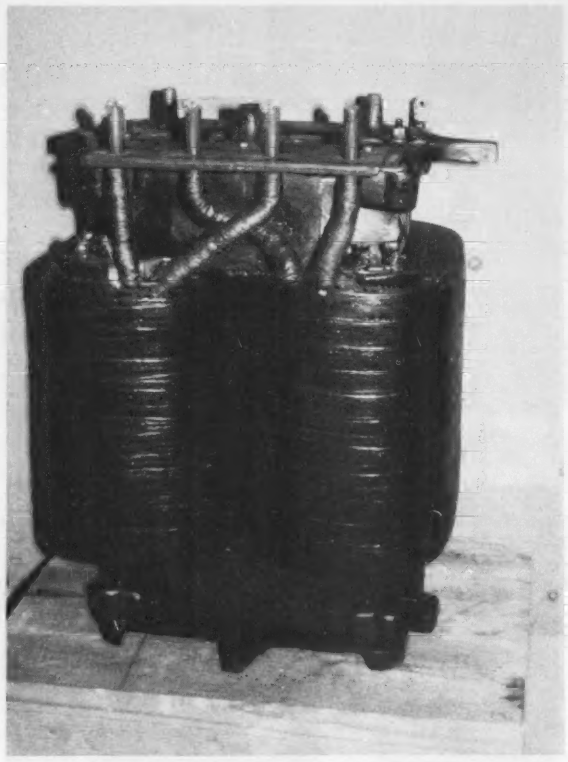

Photo D. Front view showing high-voltage terminals.

Photo E. View showing 240-volt terminals.

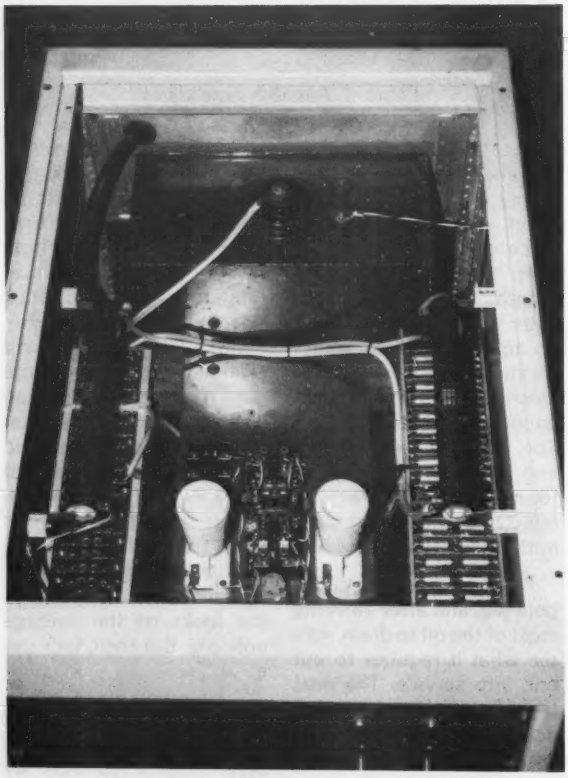

Photo F. Completed power supply.

around cabinet. A 0-to-240-volt Variac is used for controlling the dc output voltage from 0 to 5000 volts dc. The 5-kVA transformer can supply 1.5 Amperes with good regulation. Note the orange-colored device. This is a 10,000-volt-dc, 180-uF capacitor. Also, if you look closely on each side near the top, you can see the solid-state diode stacks and, immediately above them, the bleeder resistors. Note also the cone heaters and two contactors which will be explained later. This supply was designed to furnish power to a number of final amplifiers for contest work. The 180-uF capacitor and the 5-kVA pole pig are well able to supply the concurrent demands of several kilowatt amplifiers.

Photo G shows a 3-kVA transformer that represents an ideal size for a single high-power amplifier. It is in use in an amplifier using a 4-1000A in grounded grid. This particular one was dipped in black transformer insulating material, and when oven dried became a thing of real beauty. Yours truly is shown lifting it in Photo H.

Well, how do you connect a pole pig for use? The diagrams show the various input and output voltage connections. Note how the primary and secondary coils are strapped. All transformers of this type utilize two primary and two secondary windings for purposes of voltage changing. This first application shows parallel use of primary and secondary windings. Next, by connecting the secondary in series (Fig. 2), we obtain a 120-to-4800-volt transformer. The 4800-volt winding can be used either in a bridge connection or center-tapped. For a kilowatt amplifier, operating the power supply on 120-volt input is not recommended, since voltage drop

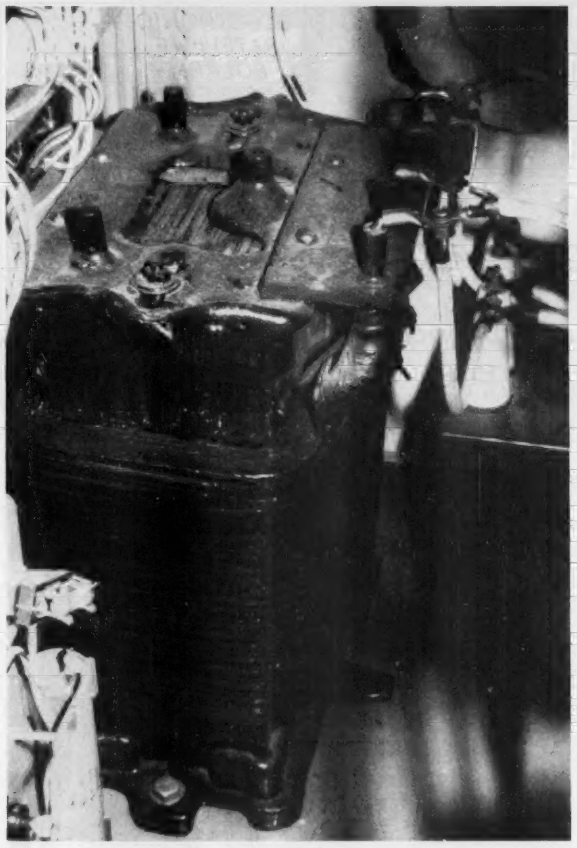

Photo G. A 3-kVA transformer, ideal size for a single high power amplifier.

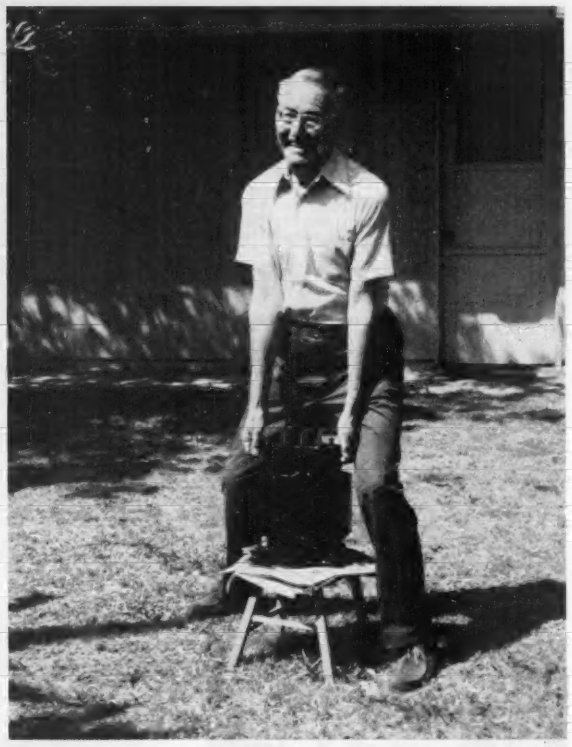

Photo H. The author lifting the transformer of Photo G.

on the primary input lines will be excessive, leading to poor regulation and efficiency.

Fig. 3 shows the connection for 240-volt input and 2400-volt output. Best use for this would be in a bridge circuit furnishing 2500 volts dc.

Fig. 4 shows the most widely used circuit. The 240-volt input is boosted to 4800 volts, which will provide 5000 volts dc in the bridge connection or 2500 volts dc in the center-tap full-wave connection.

For diode and filter protection, it is best to use a step-start circuit as in Fig. 5. This is where we use the cone heaters and the contactors. When the start switch is turned on, the first contactor operates, applying voltage to the transformer through the cone heaters acting as resistors. These limit the inrush current to a safe value for the diodes. After the filter has charged to a certain level, the voltage drop across the resistor decreases to a point permitting the second contactor to be energized. This contactor shorts out the resistors, thus permitting full voltage to be applied to the transformer. I heartily recommend the step-start arrangement. I have used it for years on supplies using 872s and solid-state diodes and never have had a failure due to excessive peak currents.

Finally, it is realized that not too much home-brewing is going on. But it is hoped that at least it may be interesting to many to become acquainted with the formerly much used pole pig. ■

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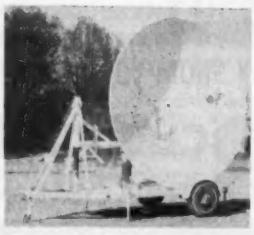

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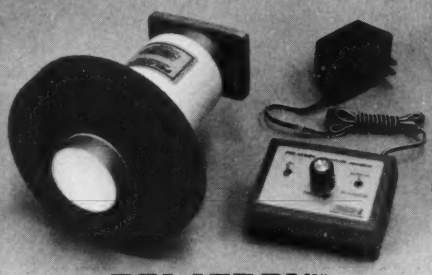

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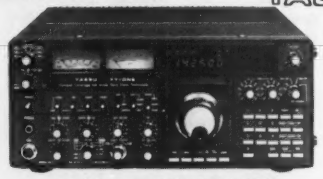

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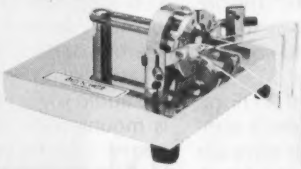

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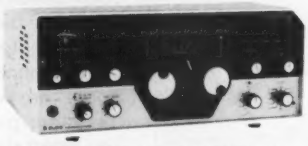

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Got an Apple? Want RTTY?

— try this hard-core interface

After spending many years using various Teletype® machines and, most recently, a less-than-adequate video RTTY setup, I finally decided to use my Apple II computer for this mode. I have owned my Apple for three years and have had the Chuck Galfo (WB4JMD) RTTY/CW software for two years.[1] The only thing lacking was the interface circuitry to connect the Apple to my ST-6 demodulator and HF/VHF radios. Galfo provides a sample interface in his software documentation, and Fig. 1 shows the block diagram of my final interface.

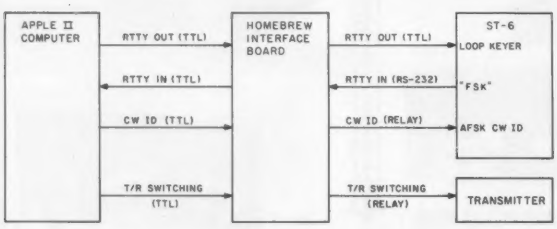

Fig. 1. Block diagram.

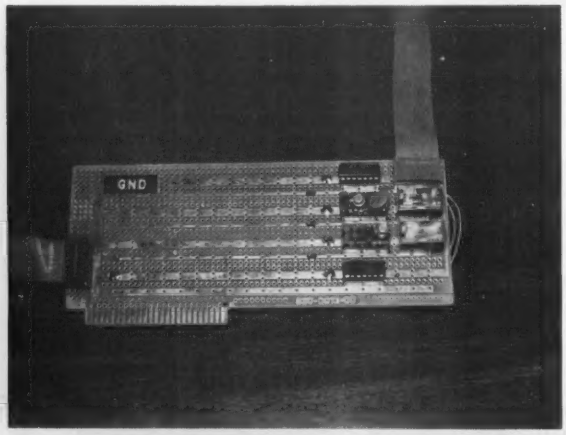

Fig. 2. The interface on an Apple prototyping board.

Interconnections to the Apple are made through the game paddle I/O port. The interface was built on an Apple prototyping board (Fig. 2) using wire-wrap; it is connected to the game paddle port through a 16-wire ribbon cable and to the outside world through a 12-pin molex® connector. The few transistors, resistors, and capacitors are mounted on two dip headers to simplify construction.

Fig. 3 is the schematic of my interface. TTL-level teletype transit pulses are available at pin 15 (AN0) of the game-paddle, 16-pin IC socket. To correctly key the loop keyer in the ST-6, these pulses must be inverted. This is done by one NAND gate of the 7404 IC. These pulses key the 2N706 transistor which in turn keys the ST-6 loop and the XTK-100 (or AK-1 depending on the age of your ST-6) AFSK oscillator for transmission of the audio tones. The 2N706 is mounted on a small PC board connected piggyback to circuit board #3 (active low-pass filter/slicer/keyer) in the ST-6. The interconnection point is indicated in Fig. 4.[2]

Received RTTY pulses are a little more difficult. The ST-6 provides both a 60-mA loop and "RS-232" (±20 V dc) pulses (FSK pin on the ST-6 rear panel). I chose to work with the FSK output, normally used to drive the FSK circuit in a transmitter, converting this signal to TTL logic levels required by the Apple using an MC1489 converter.[3] The TTL pulses are then routed to pin 2 (SW0) of the paddle port. The 6-pin AFSK-KEY/FSK-KEY molex connector on the rear panel of the ST-6 becomes the Apple's connection point. Since I use AFSK I have no need for the "FSK" circuit keying pulses; I removed the molex pin and replaced it with the line

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running to the 2N706 keying transistor.

CW ID is available at pin 13 (AN2) and keys the simple relay circuit. Transmit/Receive switching signals are outputted to pin 14 (AN1) and key an identical relay circuit as the CW ID function. T/R status is indicated by two LEDs as shown. Rather than modifying the Apple case, I mounted these LEDs in a small box and attached it to the Apple using a Velcro® strip (Fig. 5).

Operating voltages are available from the Apple power supply and appear on the prototyping board. Plus 12 V dc to operate the relays is found on pin #50 of the prototyping board. Galfo recommends that all lines entering and exiting the computer be bypassed to ground with small (200-μF) capacitors. The prototyping board documentation recommends that all voltages on the board should be decoupled with a 0.1-μF capacitor to ground near the I/O connector board pin. Do NOT use high-value electrolytic decoupling capacitors as they can cause improper operation of the Apple power supply. I highly recommend these bypasses, although I have run a kW on RTTY without them and have experienced no glitches.

A few words of caution at this point are appropriate. First, as you can see from Fig. 6, the interface board is mounted in slot #7 of the Apple and is next to my disk controller board. Since I used wire-wrapping, the component side of the interface board faces the component side of all other peripheral boards. I placed all of the wire-wrap sockets at the end closest to the keyboard. If I were to reproduce the board again, I would move the 16-pin connector going to the ST-6 to the same end as the components to preclude any interference with the disk controller board. Second, be sure that you *always* turn the power off to the computer before inserting or pulling out the interface or any other board! All cables connecting the Apple to the outside world should be shielded. I used microphone cable (two conductors plus a shield) for those lines and tied them together using small tie-wraps to form a neat cable.

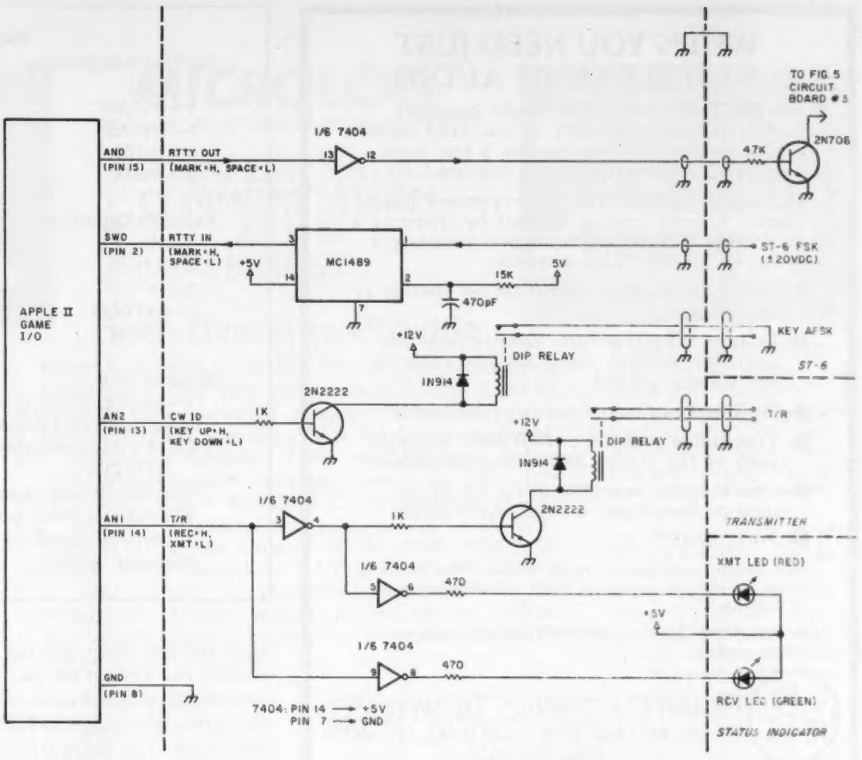

Fig. 3. Interface board schematic.

Galfo's software is outstanding. It allows you to transmit and receive Baudot and ASCII at all the popular speeds and, in fact, will operate at any baud rate between 32 and 300 baud. Split screen, automatic CW ID, prepared messages, and automatic T/R switching make operating a real pleasure. When I purchased the program it came on cassette tape, but it can easily be transferred to disk and, as careful inspection of the basic program listing shows, the disk commands to BLOAD the machine language routines are already present.

I turned my RTTY diskette into a turnkey system by making the Integer BASIC program the "HELLO" program. So all I have to do is pop the diskette into the disk drive, turn on the Apple, and the system will automatically come up with the five prompts required to initiate RTTY operation. One last caution: When the computer is on but the RTTY software is not in use, the T/R line is held in the transmit condition. Therefore, if you have your transmitter turned on it will be keyed. To fix this I simply installed a switch in the T/R line to disable this function when both the computer and my transmitter are in

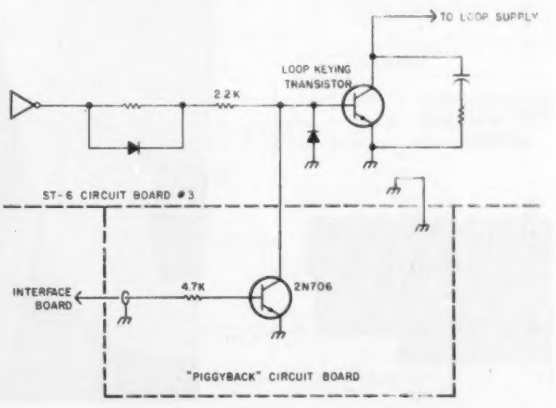

Fig. 4. ST-6 transmit keying point.

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- 1—2N706
- 2—1N914

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- 1—15k
- 1—4.7k
- 2—1k
- 2—470 Ohm
- 1—470 pF

Miscellaneous
- 1—Apple prototyping board
- 2—LEDs (1 red; 1 green)
- 2—12 V dc subminiature DPDT relay (Radio Shack #275-213)
- 1—6-inch, 16-wire ribbon cable with 16-pin IC plugs
- 16-conductor ribbon cable
- 12-pin molex connectors
- Wire-wrap sockets

use but not in the RTTY mode.

Computer RFI is a problem that has received a lot of attention lately. I am happy to report that the Apple (at least *my* Apple) does not affect my HF or VHF rigs at all. It does manage to tear up TV reception in the shack though!

Galfo's software package will also transmit and receive CW, but I have yet to build that interface. There also is a new, disk-based version of this package. It provides logging and the ability to send and receive BASIC programs, but I have not purchased it as yet.

The interface can be built for less than $50 (including the $24 for the prototyping board) and most of the parts were bought at Radio Shack. The software is available for $20-$30 depending on which version, cassette or disk, you want.

Considering the price of commercially-available interfaces, this is a powerful yet simple (and cheap!) method to put your Apple to use in your RTTY station. The interface should be adaptable to just about any other TU with minor modifications. I would be happy to answer any questions and will welcome any comments or suggestions. Please enclose an SASE with all correspondence. See you on the green screen. ■

References

[1]RTTY/CW software available from C. H. Galfo WB4JMD, 6252 Camino Verde Drive, San Jose CA 95119, or Rainbow Computing, Inc., Mail Order Dept. No. CC11, 19517 Business Center Drive, Northridge CA 91324; (800)-423-5441 (except CA); CA and foreign, (213)-349-0300.

[2]*The New RTTY Handbook*, edited by *73 Magazine* Staff, Chapter XI: Accessories.

[3]"Cross Pollinating the Apple II," Richard Campbell, *Byte*, April, 1979.

Fig. 5. LEDs box attached to the Apple's case with Velcro.

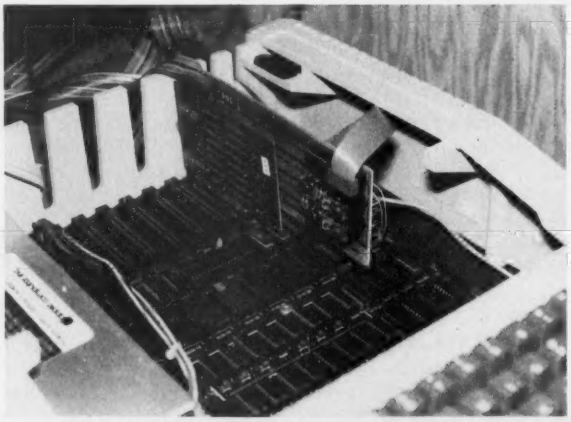

Fig. 6. The mounted interface board.

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Slow Scan	Mic Compatible Audio. Sync 1200 Hz, Black-1500 Hz, White-2300 Hz

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SYNC: Transmits "Blank-Fill" in RTTY and BT in Morse when Text Buffer is empty and unit is in transmit. Keyboard command on/off.

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Weight	15 lb.
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Size	17.8 W x 3H x 9.5D
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Color	Beige Top, Black Base
Material	AL5052 Aluminum Alloy

*Standard on ATR, Optional on ACT-1
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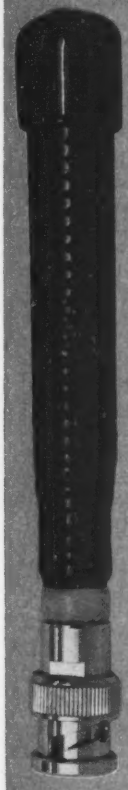

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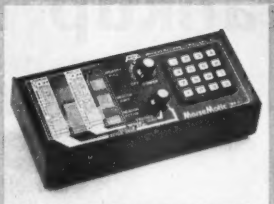
MM-2



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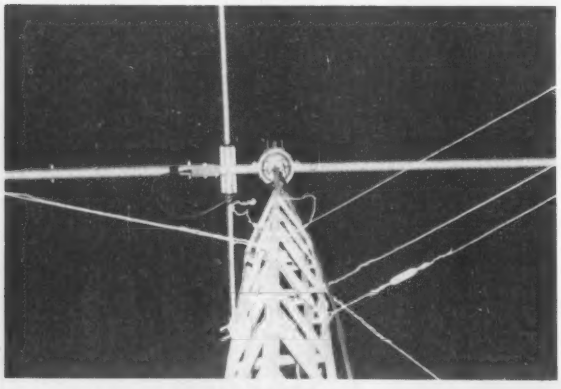
The Pleasures and Perils of Crankup Towers

—don't lose your head!

A tower is well known as one of the most beneficial station accessories an amateur may own. Standing as an outdoor monument to our superb world of long-distance communications and international friendships, the amateur's tower supports that final and most important link in his setup—the antenna. The height of such towers is usually a compromise influenced by cost, self-serviceability, and neighborhood acceptance.



A triband beam on the crank-up tower nestles in its fully-retracted position awaiting the impact of an approaching late-night storm. The photo was taken at midnight with flash and 400 ASA film.

Recently, the somewhat limited in height but highly versatile crank-up tower has gained renewed interest in amateur circles. This article will present some vital information concerning crank-up towers so that the reader may be made aware of their favorable and unfavorable aspects. In some situations, this information may provide new light for cliff-dwelling amateurs. In other situations, this information may help prevent serious personal injury to unsuspecting owners of crank-up towers. This is not to imply that crank-up towers are excessively dangerous, but rather to remind that there are right and wrong ways for using these antenna supports.

The Pleasures

Zoning laws and neighborhood restrictions are affecting an increasing number of radio amateurs each day. Unfortunately, it's becoming more and more difficult for amateurs to erect a simple triband beam on a reasonably-sized tower (40 to 50 feet). Quite often, this problem is solved with the aid of a crank-up tower mounted out of view behind a house. The antenna may thus be raised above roof level only during periods of actual on-the-air use. Additionally, if this activity is confined to night hours, darkness can cloak the raised array.

Many amateurs are not able to climb towering heights (no pun intended!) and must forego antenna tuning or repairs until a

suitable "antenna party" can be organized. Crank-up towers, however, may be erected initially against the side of one's house, and future changes or repairs may be made by the amateur while sitting or standing on his roof. If the tower is secured to the house, it may be used as a ladder to access the roof. Warning: Never climb a crank-up tower that isn't securely lowered to its resting position. An inside section could slip and break an arm, leg, or foot.

Adequate guying is another sensitive area of tower installations. Many times, upper level guys require more real estate than an amateur can provide. Limiting reasons range from guy wires obtrusively crossing established boundaries to unwarranted TVI complaints from neighbors. Two-section crank-up towers which are raised to full height only during use need to be guyed only at roof level (near the top of the lower section).

The wind-load rating of a lowered crank-up tower is much greater than a comparable full-height tower. Here in Alabama, for example, our crank-up tower and triband beam have "rode through" many extreme storms and tornado side-effects with no damage while smaller towers and antennas have been totally destroyed. (But I'd better not brag!)

Crank-up towers maintain a relatively high resale value; consequently, many amateurs secure these towers to their house and guy them at one level. The bottom section is then placed in one or two feet of dirt. This method permits the tower to change locations with the amateur, rather than being left behind in a massive pillar of concrete.

The mental (and sometimes physical!) security obtained by lowering your towering giant of an antenna to mere roof level as a violent storm approaches is sheer bliss. I speak from experience. Have you ever run out during a hailstorm and started replacing snapping guy wires as a tornado passes within a few miles of your home? Have you ever wrapped the aforementioned guy wires around yourself and held onto a swaying tree only to see your three-element quad become a rotary loop? Yes, crank-up towers are a blessing for the less-than-stout-hearted amateur!

How Crank-Up Towers Work

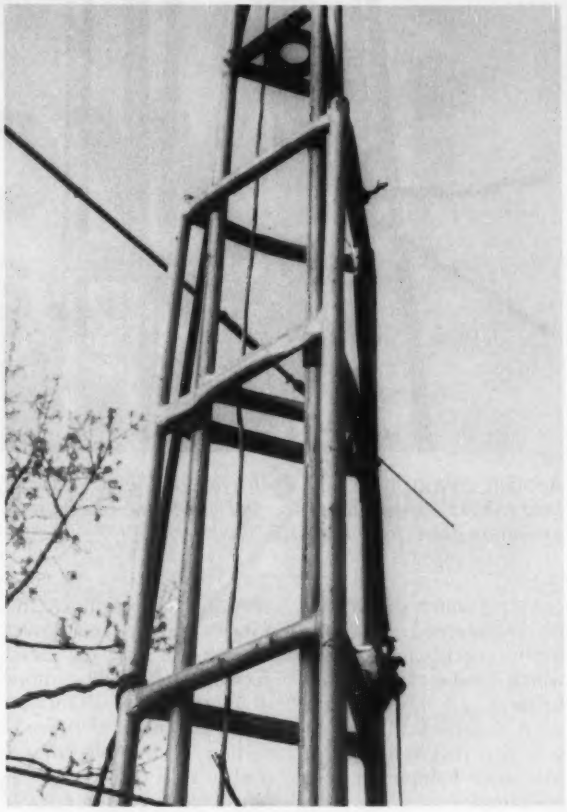
A crank-up tower consists of one or more concentric sections which move vertically on track guides within lower sections. An aircraft-type flexible cable is affixed to the smaller inside section's bottom rung, passed through a pulley near the top of the larger outside section, and fed down the tower's outer side to a winch mounted a few feet above the outside section's bottom end. As the pulley cable is reeled onto the winch, the tower's inside section is raised up toward the outer section's top-mounted pulley. A safety latch, or ratchet, is included near the outer section's top to prevent accidental down-plummeting should the operator let go of the winch crank. The latch is secured with a spring, and a control line extends downward so that it can be operated from the cranking position.

The Perils

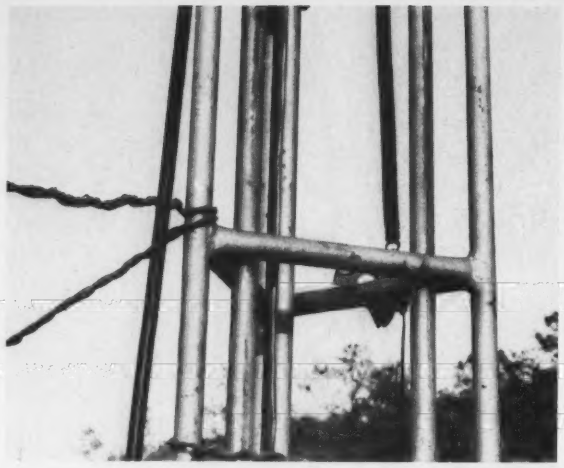
An improperly operated or unmaintained crank-up tower may, in some respects, resemble a modern guillotine. If a small, inside tower section which is weighted at its top with a triband beam uncontrollably falls straight down, it easily can sever a hand, arm, or foot which might be in its path of travel. Never rely solely on safety latches or catches for protection, and never allow any part of your body to get into a raised tower without foolproof safety backups such as concrete chocks between sections.

Assume, for example, a wasp surprise-attacks you as you're cranking a tower. If you inadvertently let go of the winch, it may rapidly unwind and crack your wrist or rib in a split-second's time. If this same tower isn't perfectly plumb, rungs on the inner section can jump the safety latches and the guillotine effect is created. Assuming you manage to get clear of the plummeting tower, the sudden stop at the bottom (fully retracted position) can snap beam elements or boom supports.

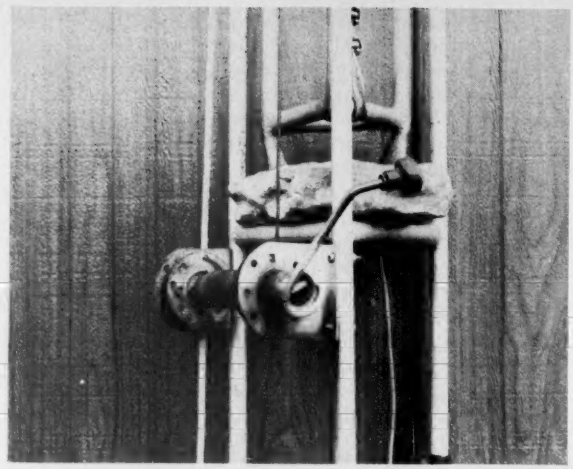
These perils can be reduced to a minimum by periodically ensuring that all safety latches operate properly, that their springs maintain ample latching pressure, *and* that additional fall-limiting chocks on raised crank-up towers are used. Ratchet teeth on the



A safety-latch system used with many crank-up towers is shown here. A spring, fastened to the top rung of the lower (outside) tower section (see tie-wire projecting out to the right), extends down to and holds firm the "C" latch, here engaged with the third rung down of the outer section. The latch can be disengaged by the safety line, here extending downward from the latch, and when the inner section is cranked up about two inches, it then can be lowered past the outer rungs. Should the operator let go of crank and safety line, the spring will slam the safety latch back in position to engage the next rung down.



Another view of the safety-latch system. The "C" latch is held in the rung by the spring. The safety line can be seen extending down from the latch.



This is the working position of the crank-up tower. Note the use of the solid chock across the rungs, preventing the inner section from descending further. Visualize this chock being replaced with a hand or arm and a cable breaking. Obviously, safety should be a priority consideration for crank-up tower owners.

cranking winch should also be maintained in sharp, toothy condition to prevent winch-handle cartwheeling. Inspect all latches and springs periodically to ensure that rust and/or corrosion isn't hampering their operation.

As an additional safety measure, an amateur might place a concrete or steel chock above the "working position" (winch location) to prevent personal injury should a cable snap during cranking. Also, an auto's front wheel spring can be placed inside the larger tower section at ground level to cushion any accidental inside section drops.

Occasionally, an amateur may raise his crank-up tower slightly higher than suggested by the manufacturer. If the tower is leaning 3 or 5 degrees from perfect plumb, the upper section can tilt and become stuck at this height. Hmmm—a cocked guillotine!

First, never raise an unplumb crank-up tower to a point where over one-third of the moving section is above its larger lower section. If, however, such misfortune does occur, the amateur must cautiously free the off-center stuck section. Double-chock the tower's upper and lower sections to limit the freed section from falling more than a couple of inches. Then, assuming the tower is resting against the house roof or side, climb atop the house (via a ladder, not via the tower!) and gently straighten up and reinsert the upper section while an assistant keeps pressure on the winch and controls the safety-latch line. This is not a difficult maneuver; it merely requires caution. I've done this single-handed by keeping pressure on the winch while pushing the moving section back straight and then slowly unwinding the cable (and lowering the upper section). I wouldn't care to try this daredevil stunt very often, however.

It's possible that an unexpected killer storm can arise during that once-a-year occasion when an amateur forgets to lower his crank-up tower. Sorry 'bout that (maybe my next article will describe tower straightening techniques). Plan ahead. Either install permanent guys and chocks, seldom lowering your tower, or make tower-lowering part of your amateur activities. A properly maintained tower can be raised or lowered within 2 or 3 minutes, and it's *great* exercise!

Some of the smaller crank-up towers do not have room inside their top sections for mounting large rotors. Consequently, the rotor must be mounted above the top section. Wind force in this case will be directed against the rotor rather than the tower, since a thrust-bearing arrangement cannot be utilized. Assuming a relatively large rotor and reasonably-sized beam are used, few problems need be expected, particularly if the tower is retracted to minimum height during periods of non-use. In other words, pick your antenna and rotor size according to your use and future plans—and don't overrate their capabilities. A 40-dollar rotor mounted atop a tower can't handle a full-size 20-meter beam!

Crank-Up Tower Maintenance

Crank-up towers, like any mechanical devices, require occasional maintenance for reliable and long-term operation. Basically, this maintenance consists of oiling tower sections at points of friction, oiling the pulley(s), cable, and winch bearings, plus oiling the safety clamp(s) and tightening springs as necessary. Regular 20- or 30-weight auto oil is perfect for this application. A few drops placed at the top of each section's corners will slowly run down the section's length and spread into its runners. This procedure may also be applied to the pulley cable. Finally, guy wires can be rechecked and their turnbuckles adjusted as necessary to maintain exact plumb.

Conclusion

Assuming that safety and maintenance rules are diligently respected, the crank-up tower should prove a cherished accessory for any amateur. Limited height, two-section crank-ups are extremely useful for antenna experimenters or amateurs faced with structure limitations. The beauty of variable-height, accessible support is hard to beat, but don't overlook safety precautions. Antenna accidents are the leading cause of injuries to today's radio amateurs. ■

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The Incredible Antenna Mark 2

—a complete HF allbander in a very small space

Seven years ago I wrote an article titled "The Incredible 18-Inch Allband Antenna" (*73 Magazine*, March, 1975). Since that time there have been many variations built. The original antenna had some severe intermodulation problems which made extra signals appear just where you did not want them. My project was satisfactory for locations far from other radio stations, but not good for cities. The Incredible Antenna Mark 2 solves these problems.

The antenna is remarkable because it covers the entire shortwave band from the AM broadcast band up through the 10-meter band and is compact enough to sit on top of any receiver.

This antenna functions very differently from ordinary antennas. Imagine for a moment that any two conductors in the universe form the plates of a capacitor. If they are an inch apart they form a capacitor, and if they are 1,000 miles apart they still form a capacitor. Naturally, the impedance of a capacitor with a 1,000-mile spacing is going to be very, very high. So what we want to do is build a very, very high input-impedance, active-circuit transformer to convert down to normal transmission-line impedances. If a little amplification is done at the same time, so much the better.

Photos by Carroll Haugh

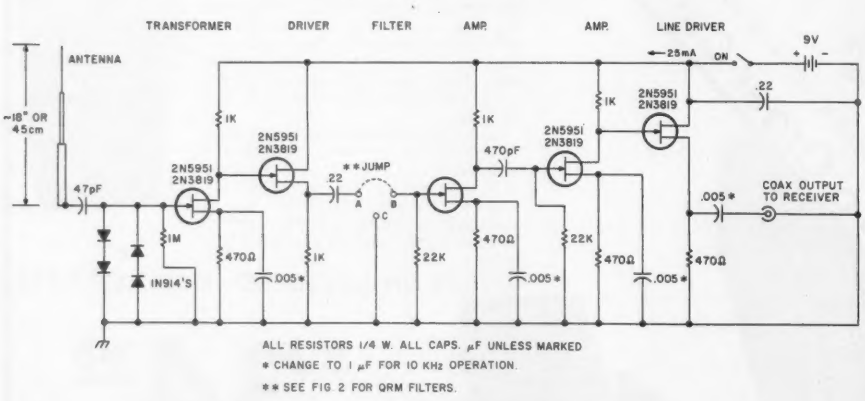

Fig. 1. Schematic for the 18" allband antenna.

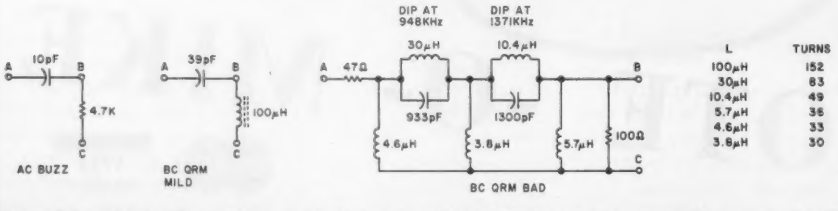

Fig. 2. QRM filters. All coils are ¼" diameter and ¼" long. Use #30 or smaller enamel wire.

The amplification of the improved antenna system shown in Fig. 1 is done by common rf field-effect transistors. Using FETs made a great improvement in the spurious signals. Note the terminals marked A, B, and C. These are for insertion of filters to remove local broadcast stations. Try jumpering A and B together first. If interference shows up, then add the appropriate filter from Fig. 2.

As for building the Mark 2, I used all common disc-ceramic or mylar™ capaci-

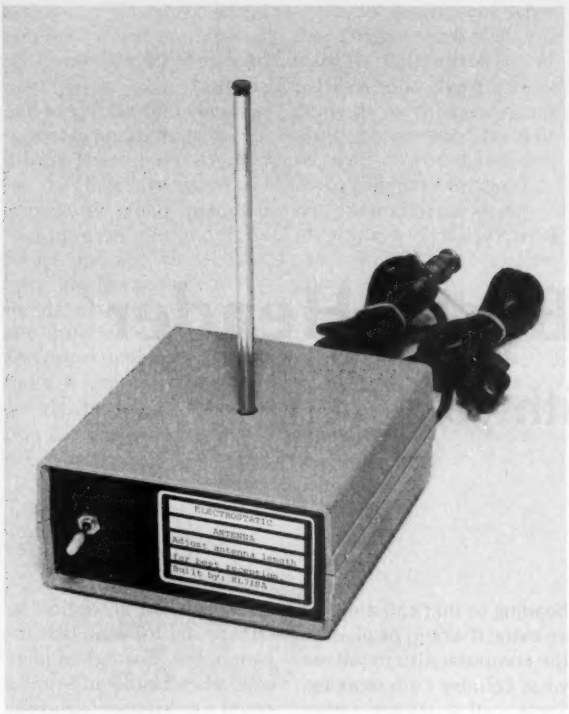

Photo A.

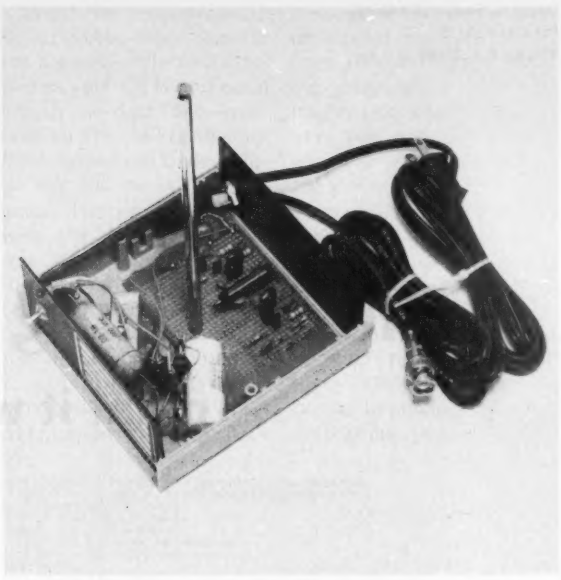

Photo B.

tors, carbon-film resistors, and FETs purchased from the local Radio Shack store. (I recommend 2N5951 FETs if you can get them, but 2N3819s do work.) All of this is mounted on perforated phenolic board. Leads should be kept short as is conventional in rf practice, and I used a number 18 AWG wire to form the ground bus. Make sure that there is as little capacity between the antenna rod and ground as possible. Don't use coax between the board and the rod; use an old-style ceramic feedthrough insulator for the rod or at least a large plastic support to keep the ground capacity low. I found that a replacement-type antenna designed for a transistor radio was ideal because it allowed me to adjust antenna length to reduce local interference.

If you are wondering about adding a power supply, watch out for electrostatically-induced hum. The voltage can be anywhere between 9 and 14 volts, but it is necessary to bypass the ac line to the antenna ground or, even better, use a wall-mount, calculator-style power supply. Internal power supplies will require that you shield the transformer and power line. If this is not done, then you will have CW signals modulated by ac hum. The easiest power supply is a good 9-volt battery.

Last time I wrote about the antenna, some low-frequency SWLs wanted to know if this would work all the way down to 10 kHz. The answer is yes, but only if the .002-uF capacitors are changed to 1 uF. Naturally, it becomes much more prone to power-line noise when you do this, and I don't recommend it unless you need the additional coverage. Using a very narrow-band receiver, I have been able to receive a Ft. Collins, Colorado, audio frequency station, but it was only marginal on an 8-foot rod.

I figure this project will cost $25 and two evenings, one to get the parts and another to build the antenna. It will open the lower frequency ham bands and the international shortwave bands to everyone with a receiver. I'm already working on the next version for use in my car with an integral noise blanker. ■

Parts List

1—1 megohm, ¼ W
2—22k Ohm, ¼ W
4—1k Ohm, ¼ W
4—470 Ohm, ¼ W

1—47 pF ceramic
1—470 pF ceramic
4—.005 μF ceramic
2—.22 μF (272-1070)

5—2N5951 (preferred), or 2N3819 (276-2035)
4—1N914 (276-1620)

1—Switch, SPST (275-324)
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1—Battery holder (270-326)
1—Perfboard (276-158)
1—Battery snaps (270-325)
1—Box, plastic (270-218)
1—Antenna replacement (15-232)

(Radio Shack numbers given.)

If you really want to figure out how much capacitance there is between two identical rod antennas, then solve the following simplistic equation for a 10-cm spacing, and then for a 100-km spacing. For the academically inclined, the results are worth the effort. With L = length of wires in meters, D = spacing in meters, r = wire radius in meters, and C = capacity in pF, then

$$C = 17.7\pi L \left\{ \text{Cosh}^{-1}\left[\frac{D^2 - 2r^2}{44}\right] \right\} - 1$$

Where: $\text{Cosh}^{-1}x = 1n\,[x + (x^2 - 1)^{1/2}]$

David C. Swaim WA4NAG
PO Box 720126
Atlanta GA 30358

The Amazing Beam Header

—point it with your Pet

Many of us have beam antennas we use for working DX stations. As you probably are aware, the rotatable-beam antenna is of little advantage unless you know where to point it to work a given station or country. There are maps available which can be used for ballpark estimates of the headings, but I find that these usually are centered somewhere else besides where I am.

I have one of these maps, but I find that to use it I first must determine what country the station is in and then locate the country on the map. The problem is that while I usually hear the DX station call, sometimes I never hear what country he is in; by the time I find the prefix in a country list and locate the country on the map, either the band folds or the station moves on. If you operate a fast-paced contest, you do not have the luxury of taking more than a second or two to point the beam.

It was during one of those contest weekends that I looked over at my Commodore Pet microcomputer and asked myself, "What if. . .?" What if I loaded a cross-reference list of call prefixes and countries into the computer so it could look up any call prefix and tell me what country it is in? What if I also loaded the latitude and longitude of the country into the computer? Then I could just type in the call prefix and have the microcomputer calculate the proper beam heading.

From that point on, the contest was a total loss. I spent the rest of the weekend (actually the next two weeks of my spare time) on the microcomputer, working on a beam-heading program.

The idea of writing a beam-heading program had crossed my mind a time or two before, and already I had definite ideas of what I wanted. Naturally, I wanted to be able to input a call prefix and get back a beam heading to that call area. As an extra, it would be nice for the computer also to tell me what country I am working. Some call areas are rather large, and the beam heading for one city may be significantly different from that for another city in the same area. So it would be nice if the computer also would give me several cities within a given large country or call area (such as Canada or Mexico).

I work mostly SSB, and many of the phone stations in the US and Canada will give their city and state when they call CQ, so it would be nice to have a look-up by city and state or province. Since I have a printer connected to my computer, I wanted to be able to dump a list of all locations with headings to each. If I had an option to change my location (the location the beam headings would be calculated from), I could run lists for friends in other cities.

```
CHOOSE AN OPTION

 0.  FIND BEARINGS TO GIVEN CALL PREFIX
 1.  FIND BEARING TO GIVEN CITY
 2.  FIND BEARINGS TO GIVEN COUNTRY
 3.  PRINT BEARINGS TO MAJOR U. S. CITIES
 4.  PRINT BEARINGS TO MAJOR CANADIAN CITIES
 5.  PRINT BEARINGS TO MAJOR FOREIGN CITIES
 6.  PRINT BEARINGS TO ALL MAJOR CITIES
```

Fig. 1. This is the menu of options available in the beam-heading program. The options which say "find" will print on the video screen. The options that say "print" direct their output to the printer.

The program listed with this article is what I ended up with. It begins by reading the data on each city. This data is illustrated beginning on line 5000 and includes the call prefix, city (and state or province for the US and Canada), country, and latitude and longitude. As you add or delete cities in the data, be sure to put the correct number of cities on line 110. The variable N is used throughout the program in loops to save having to change every loop each time you add or delete a city. A 16K Pet will hold data for about 150 cities. You can get latitude and longitude data from an almanac or a good atlas.

Once the cities are all loaded, the program must obtain your latitude and longitude. It does this by asking for your city and state and looking it up in the data. (Input your city followed by the two-letter abbreviation for the state; do not put a comma between the city and state.) If it cannot find your city and state, it will

ask you if you want to try another city. If you answer no, it will then ask for you to direct-input your latitude and longitude. From here on out, the program is menu-driven. The menu is listed in Fig. 1. There are seven options in the menu, including four print options and three screen options. For each option, the program searches the data based on the given key (prefix, city, country) and prints or displays what it finds. A sample of what you get on the screen from option 2 is shown in Fig. 2.

If you answer yes when the program asks if you want the data sorted by call prefix (a good idea if you are going to use the printing options), be prepared for a little wait if you have very many locations to sort. I do not pretend to be an expert in sorting, and I did not write this sort in machine language—which would have been faster but more difficult to adapt to different computers. At any rate, it will take a few minutes to sort if you have a hundred or more locations in the data.

What the program must do is find the initial heading for a great-circle route between your QTH and each city in the data. The equations in *The ARRL Antenna Book* turned out to be of little use for me in this program. The problem I had with the ARRL equations was that I needed to take the arc cosine of the angle. My microcomputer's BASIC has only the arc tangent. For the solution to this problem, I went to my trusty math handbook and found a set of equations called Napier's Analogies. The algorithm I developed from this is on lines 1000 through 1320 of the program. It was thoroughly tested before I put it into this program and it works for any two points on the globe.

For those of you who may want to put this program on a microcomputer other than a Commodore, let me mention some small details. First, the CHR$(1) in the heading print subroutine (lines 4000–4140) tells the printer to enhance the print on that line. (A sample page

Program listing.

```
10 REM ************************
20 REM * BEAM HEADING PROGRAM *
30 REM * BY DAVID C SWAIM II  *
40 REM *     AUGUST 1981     *
50 REM ************************
100 POKE 59468,12
110 H=12
120 DIM P$(N),M$(N),C$(N),LA(N),LO(N),S(N)
130 PRINT"■■■
```

of the output list is included here which shows this enhanced printer.) The second thing is the trick I play with the input for the options. Before each input statement, there is a print statement which prints what appears to be blanks. They are actually shifted blanks. The input statement then backspaces over the shifted blanks. This means that if you just hit the return key in response to any question, the program will not get a null entry and blow up. Instead, it will get the shifted blanks. It then checks for shifted blanks and recovers to another part of the program.

If you are in one of the options, say the lookup-by-call-prefix option and give a null entry (just hit return), the program will branch back to the menu. If you just hit return in the menu, the program will branch back to requesting your city name. This allows you to change your location without having to exit the program and start over in reading and sorting all the data again. If you just hit return when you are asked for your city, you will exit the program.

I find that this program can help me get contacts I might otherwise miss from not having my antenna pointed in the right direction. It does everything except point the beam for me. Now, let's see, if I can wire the computer into the rotator control box. . . ■

```
BEARINGS TO AUSTRALIA

VK5 ADELAIDE  AUSTRALIA      256
VK4 BRISBANE  AUSTRALIA      261
VK8 DARWIN  AUSTRALIA        295
VK3 MELBOURNE  AUSTRALIA     250
VK6 PERTH  AUSTRALIA         270
VK2 SYDNEY  AUSTRALIA        253

ENTER COUNTRY ?
```

Fig. 2. This is what is printed on the video screen if you request option 2 and ask for Australia for the country. Note that in each case the call prefix, city, country, and beam heading are printed.

BEAM HEADINGS FROM ATLANTA GA TO FOREIGN CITIES

PREFIX	CITY	COUNTRY	BEAM HEADING
5A	TRIPOLI	LIBYA	58
5R8	TANANARIVE	MADAGASCAR	83
5Z4	NAIROBI	KENYA	73
6W8	DAKAR	SENEGAL	90
6Y5	KINGSTON	JAMAICA	154
7X	ALGIERS	ALGERIA	59
8R	GEORGETOWN	GUYANA	132
9M2	SINGAPORE	MALAYSIA	346
9Q5	KINSHASA	ZAIRE	88
BY	PEKING	CHINA	344
BY	SHANGHAI	CHINA	336
BY	CHUNGKING	CHINA	264
BY	CANTON	CHINA	341
BY	NANKING	CHINA	339
CE	SANTIAGO	CHILE	168
CE	IQUIQUE	CHILE	164
CM	HAVANA	CUBA	170
CP	LA PAZ	BOLIVIA	160
CT1	LISBON	PORTUGAL	61
CX	MONTEVIDEO	URUGUAY	156
DL	HAMBURG	WEST GERMANY	40
DL	BREMEN	WEST GERMANY	41
DL	MUNICH	WEST GERMANY	45
DL	FRANKFURT	WEST GERMANY	44
DM	BERLIN	EAST GERMANY	40
DU	MANILA	PHILIPPINES	329
EA	MADRID	SPAIN	58
EA	BARCELONA	SPAIN	55
EI	DUBLIN	IRELAND	44
EP	TEHERAN	IRAN	35
F	BORDEAUX	FRANCE	52
F	LYONS	FRANCE	50
F	MARSEILLES	FRANCE	52
F	PARIS	FRANCE	47
FY7	CAYENNE	FRENCH GUIANA	127
G	PLYMOUTH	ENGLAND	47
G	NEWCASTLE-ON-TYNE	ENGLAND	42
G	LIVERPOOL	ENGLAND	44
G	LEEDS	ENGLAND	43
G	LONDON	ENGLAND	45
G	BIRMINGHAM	ENGLAND	45
G	MANCHESTER	ENGLAND	43
G	BRISTOL	ENGLAND	46
GI	BELFAST	NORTHERN IRELAND	43
GM	EDINBURGH	SCOTLAND	41
GM	ABERDEEN	SCOTLAND	39
GM	GLASGOW	SCOTLAND	41
HA	BUDAPEST	HUNGARY	43
HB	ZURICH	SWITZERLAND	47
HC	GUAYAQUIL	ECUADOR	172
HK	BOGOTA	COLUMBIA	160
HP	PANAMA CITY	PANAMA	168
HS	BANKOK	THAILAND	353
HZ	MECCA	SAUDI ARABIA	52
I	NAPLES	ITALY	51
I	ROME	ITALY	51

Fig. 3. Sample of beam-heading list.

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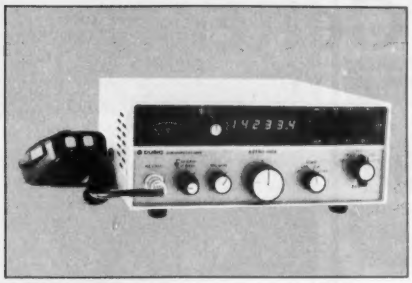

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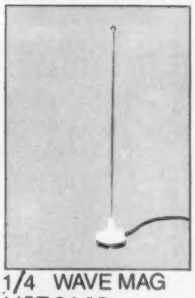

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I have always been interested in antenna design, and the amateur microwave bands permit experimentation with scaled-down antennas. The short wavelengths permit the testing of designs without a hundred-acre antenna farm. However, a lack of activity limits the testing and application of the antennas. Recently, MDS television service was added to this area, providing a reliable, constant-power microwave signal for antenna testing.

The transmitting antenna is located several miles away—hence it approximates a far field source. (My microwave-antenna range is a second-story window.) The frequency, 2.15 GHz, is high enough to keep the antenna size down to a practical level yet not so high as to make construction tolerances beyond amateur capabilities. Gain comparisons are made by placing an attenuator between the microwave converter and the television receiver and noting how much attenuation must be added or removed to maintain a constant signal level.

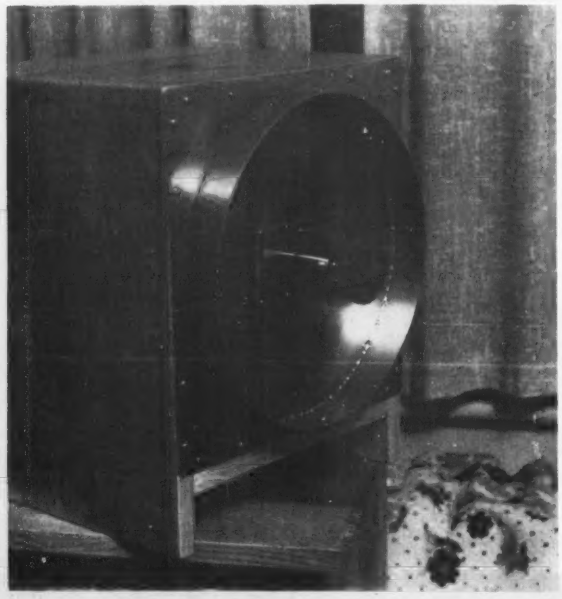

Photo A. Antenna on a test mount.

The first antenna I tried was the popular coffee-can horn. Since then, it has become my standard to which all other antennas are compared. Other horn and helix antennas have been constructed and tested, but have one major drawback: their long length. I decided to try a more compact planor antenna. Collinears and other phased arrays were ruled out because of problems with the phasing lines. Digging through my file on antennas, I ran across the short backfire and constructed the antenna shown in Fig. 1. Several feeds were built and tested. The first used a microstrip disk and offered no better gain than the coffee can. The final feed is the one used on the original design.[1,2] It consists of a slot-fed dipole with a small disk-shaped reflector. The dimensions shown are in terms of wavelength, making frequency-scaling to 1296, 2304, or other frequencies easy.

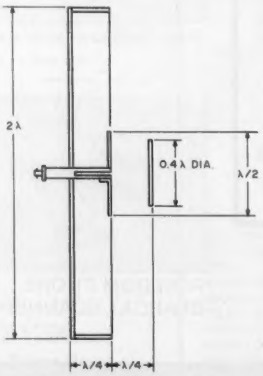

Fig. 1. Short backfire antenna.

The ground plane is made from a 300-mm (1-foot)-square piece of single-sided PC board. Other materials, including screen wire, could have been used. Another piece of single-sided board 35 mm by 864 mm (1⅜" by 34") was formed into a circle and the ends butted together. A small piece of board is epoxied so that it overlaps the joint. After curing, the ring was edge-soldered to the ground plane, forming

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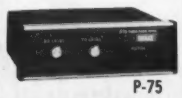

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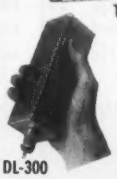

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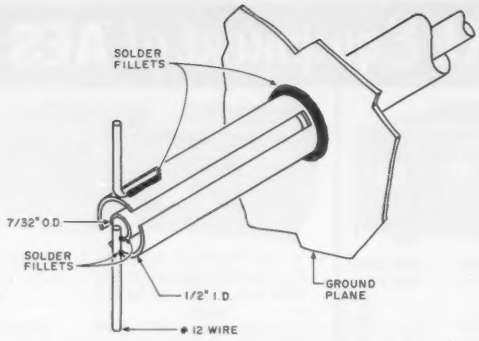

Fig. 2. Dipole-feed details.

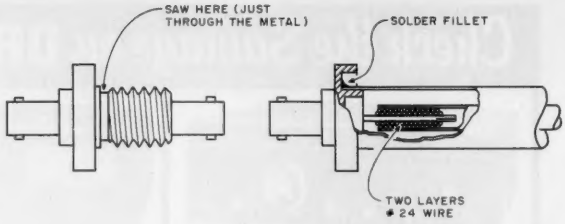

Fig. 3. Connector details.

an open cavity two wavelengths in diameter and one-quarter wavelength deep. I drilled a hole pattern in the cavity center to allow experimentation with different feeds or rotating the feed polarization. The radiation pattern is symmetric with a half-angle response of 30 degrees to the −10-dB level.

The dipole feed is formed from two concentric pieces of thin-wall brass tubing that comes in telescoping sizes at a local hobby shop. The outer conductor has an internal diameter of one-half inch. The inner conductor has an outer diameter of seven thirty-seconds inch. The construction details of the dipole and the connector are shown in Figs. 2 and 3, respectively. Note that one dipole element shorts the inner and outer conductors together. The other stops at the outer conductor.

The dipole feed is assembled by first sawing through the outer sleeve of a BNC bulkhead feedthrough and discarding the threaded portion. The exposed inner conductor is built up with two layers of number 24 bare wire. The brass inner conductor tubing is slotted for about 10 mm, slid over the built-up inner conductor, and the assembly is sweat-soldered together. The inner conductor is intentionally left too long and will be trimmed later.

Next, the outer conductor is cut to length (not critical) and slotted. The two slots are each one-quarter wave long. Slotting is best done by first inserting a one-half-inch diameter dowel rod in the outer conductor to prevent buckling. The slot width is a nominal one-sixteenth inch. The outer conductor is then slid back over the inner conductor assembly and the inner conductor length is marked. After trimming the inner conductor and removing any burrs, the assembly is joined together with a solder bead around the coax fitting. A hole slightly larger than the outer conductor is drilled in the center of the ground plane or support plate if you intend to make interchangeable feeds. The outer conductor is soldered in place with the slot roots flush with the front surface.

The dipole elements are added last. They are made from number 12 bare wire. The element that shorts the inner and outer conductors doubles as a support for the inner conductor. The subreflector disk is epoxied on two half-wavelength-long wooden posts. I used wood instead of polystyrene because it was convenient.

Although adjustments aren't normally required, it should be easy to replace the dipole wires with telescopic tubing to permit fine tuning. My tests show that the short backfire has a gain of 8 to 9 dB over the horn, a level between large, high-gain antennas and simple dipoles. ■

References

1. H. W. Ehrenspeck, "The Short Backfire Antennas," *Proceedings of the IRE*, No. 53, pp. 1138–1140 (August, 1965).
2. Dr. Akhileshwar Kumar, "Backfire Antennas Aim At Direct Broadcast TV," *MicroWaves*, April, 1978 (contains 83 references).

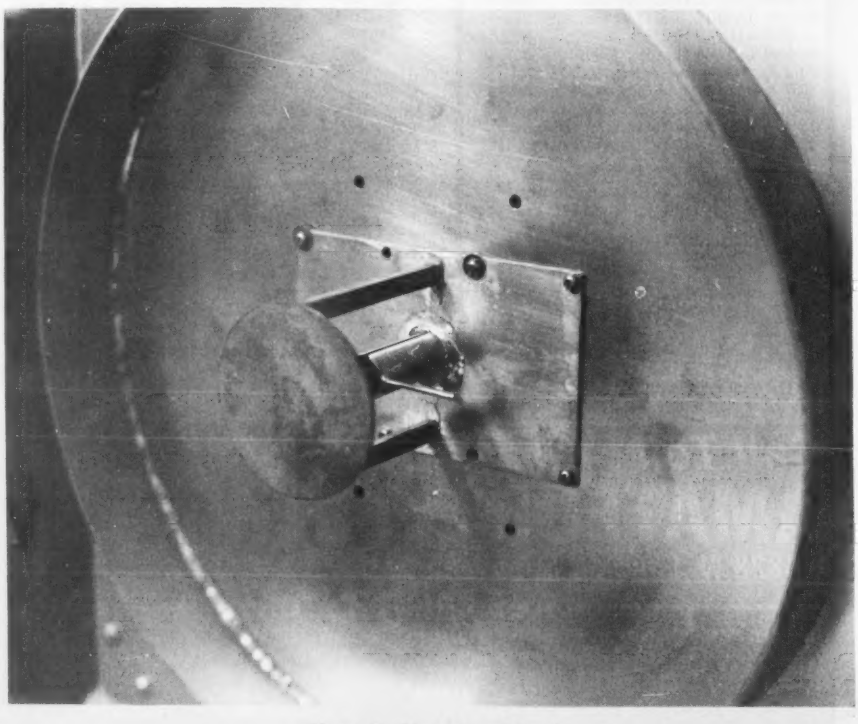

Photo B. Close-up of feed.

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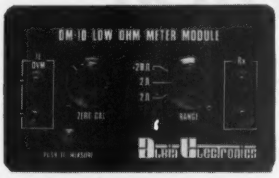

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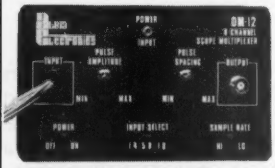

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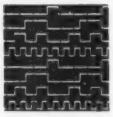

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Space limitations often dictate the use of a vertical antenna on city lots. After a recent move, I found myself faced with this kind of situation. But not only was there insufficient space for any kind of horizontal antenna, there wasn't even room enough for a ground-radial system for my proposed vertical! Putting the thing on the roof was just out of the question. The landlord wouldn't allow any defacing of the physical plant.

In order to get on the air with any sort of efficient radiator, I would have to build it to meet the following set of requirements:

- It had to be put on the smallest possible amount of real estate, preferably only a few square feet.
- It could not have any ground-radial system (a condition essentially dictated by the above requirement).
- It had to be relatively unobtrusive—no complicated set of spears or prongs or guy wires—lest somebody complain and start imagining all sorts of horrible RFI.
- It had to be efficient, since my intent was to run QRP.
- It had to cover 20, 15, and 10 meters.

This may sound like a mutually exclusive set of parameters, but it's not!

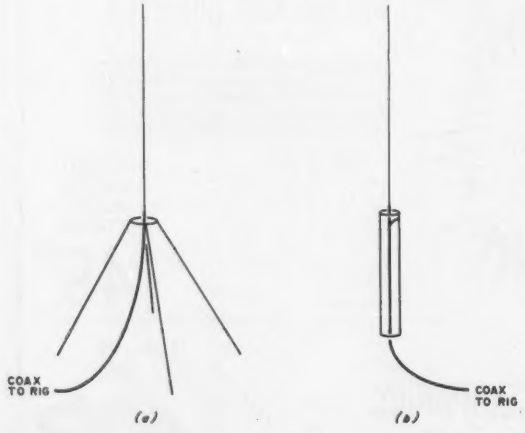

Fig. 1. (a) The conventional ground-plane antenna, with a quarter-wave vertical radiator and three quarter-wave radials. (b) A modification of the ground plane where the radials are replaced by a single quarter-wavelength section of tubing through which the feedline is run. The center conductor of the coaxial feedline should be connected to the top section in both cases.

The Vertical Dipole

The antenna described here is a multiband vertical dipole. It was developed as a modification of the familiar ground-plane antenna shown in (a), Fig. 1. A ground-plane antenna, elevated so the feedpoint is at least a quarter wavelength above the ground, requires only a few resonant (quarter-wave) radials in order to have excellent efficiency and low-angle radiation. But suppose that, instead of the radial wires shown at (a), a single length of tubing is used, as shown at (b)? A 20-meter antenna of this va-

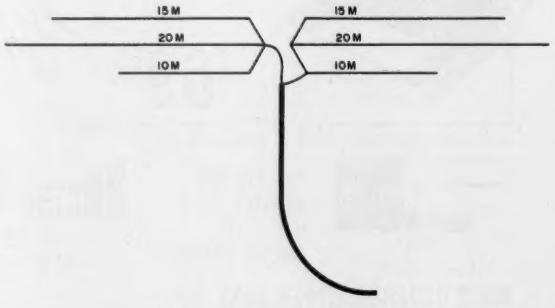

Fig. 2. Connecting three dipole antennas in parallel to get three-band operation. On a band where one of the dipoles is half-wave resonant, the other two are nonresonant and thus do not contribute to the system in any way.

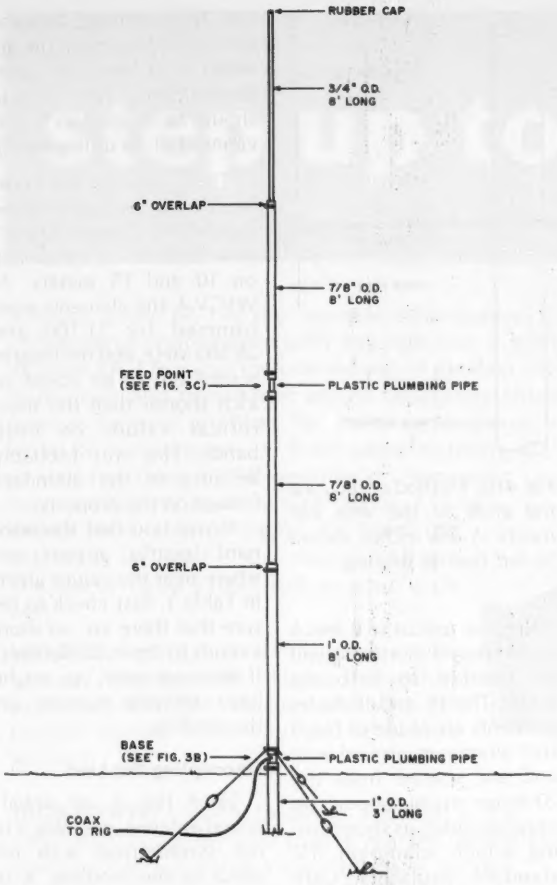

Fig. 3 (a). The overall construction of the 20-meter main support is shown. The tubing is slit and clamped together with hose clamps. Overall height, assuming the base is 2 feet above ground level, is just over 33 feet.

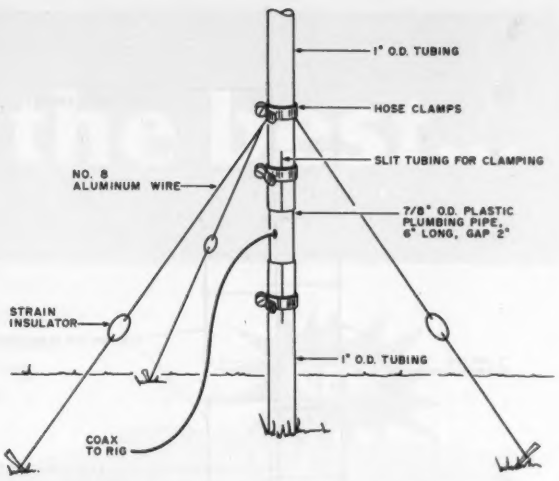

Fig. 3 (b). The base mount, showing the 20-meter pruning wires which act as reinforcement for the plastic pipe.

riety was constructed and tested at W1GV/4 and was found to perform exceptionally well.

How does an antenna such as that shown in (b), Fig. 1, work? Actually, it can be thought of as simply a ground-plane antenna in which the set of radials is brought straight down from the feedpoint. It may also be thought of as a vertical dipole in which the feedline is brought in from the underside, directly through the lower radiating section. However you want to visualize this antenna, though, it works—well!

Multiband Operation

One of my requirements for this antenna was that it have multiband capability. Because of the feed method, adding traps did not appear feasible. (It would not be a good idea to run the coax through the trap inductors.) One technique, commonly used with home-brew multiband dipole arrangements, came to mind: Simply place the dipoles for each band in parallel. Fig. 2 illustrates this scheme.

This kind of antenna will work very well on 20, 15, and 10 meters; on each band, the antenna cut to the proper length would accept and radiate electromagnetic energy, while the other two antennas would not, since they would be poorly matched. The result would be good low-angle radiation and true ½-wavelength resonance on all three bands.

The only possible problem seemed to be how to physically construct the "multiple vertical dipole" antenna. This proved easy, requiring only a modification of the existing 20-meter vertical dipole.

Construction of the Main Support

Fig. 3(a) shows the construction of the 20-meter antenna which forms the main support for the structure. Aluminum tubing is used for the radiating elements, with 1-inch o.d. at the bottom tapering to ¾-inch o.d. at the top. The 8-foot sections overlap 6 inches, so each side of the dipole is 15 feet 6 inches high. To obtain exact resonance, three short lengths of No. 8 soft aluminum ground wire are attached to the base, as shown. They should be trimmed so the swr is minimum at the desired frequency. A good starting length for the wires is 18 inches. Strain insulators should be used so the wires can provide extra support for the antenna base; otherwise, high winds might cause the antenna to blow down. (It's over 30 feet high!)

Fig. 3(b) is a close-up drawing of the base mount. A short piece of ⅞-inch o.d. plastic pipe is used to insulate the antenna base from the ground. The feedline, consisting of RG-58/U coaxial cable, is fed through a 5/16-inch hole in the side of the pipe, upward inside the lower part of the antenna, to the feedpoint.

Fig. 3(c) shows the construction of the center feedpoint. A short section of ¾-inch o.d. plastic pipe is

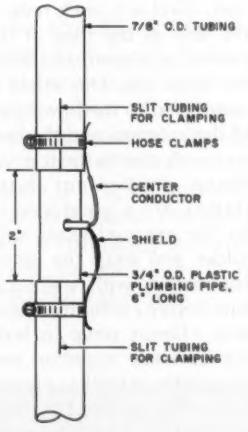

Fig. 3 (c). The feedpoint. To reduce the chances of corrosion, the entire feedpoint connection should be wrapped with electrical tape before the hose clamps are installed.

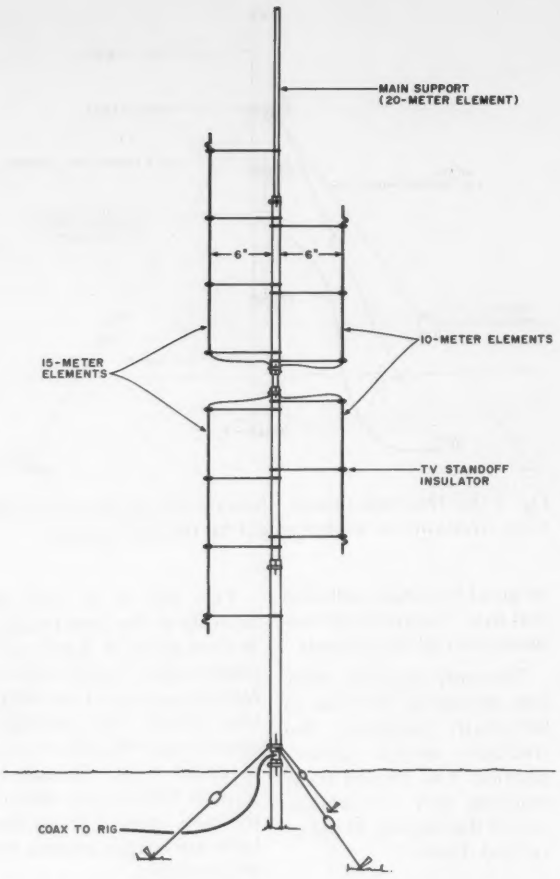

Fig. 4 (a). Overall picture of the completed vertical dipole. The 10- and 15-meter elements are spaced 6 inches from the main support.

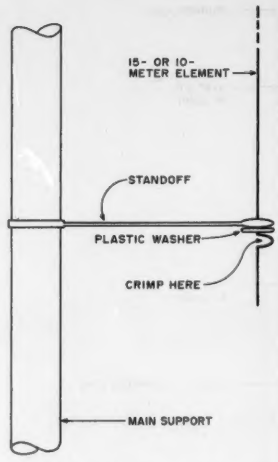

Fig. 4 (b). Method of securing the ends of the wire elements. A few inches should be left free for pruning.

used. Drill a 5/16-inch hole in the side of the pipe at the center, as shown, and bring the coax out. The shield is connected to the lower part of the antenna, and the center conductor to the top, via those convenient hose clamps. It's a good idea to tin the exposed leads with solder and wrap the entire connection with electrical tape before clamping. Those hose clamps serve to hold the antenna together mechanically as well as electrically, so be sure to put them on tight. You might even want to put a separate pair of clamps on the tubing independent of the electrical connections to ensure rigidity of the structure.

Since this antenna is quite large, it is important that the base mount be properly assembled. The tubing at the bottom should be driven at least 12 inches into the ground. The set of resonator/guy wires should be tight, have a slant of at least 45 degrees to the vertical (less than 45 degrees to the horizontal), and their anchors should be *very* secure. Also, don't forget the little rubber cap at the top of the thing! Little details like this could be responsible for an early demise if neglected.

Adding 15 and 10 Meters

Fig. 4(a) shows the complete antenna, illustrating the installation of the 15- and 10-meter elements. The 15-meter elements should be precut to 11 feet 2 inches; the 10-meter elements should be precut to 8 feet 6 inches (some shortening will be needed to resonate them). The 15- and 10-meter elements are made of No. 8 soft aluminum ground wire and are spaced from the 20-meter main support on opposite sides, as shown, using 6-inch clamp-on TV standoff insulators. Care must be taken to see that the wires do not come into contact with the 20-meter element, except of course at the feedpoint. Electrical contact at any other point will disturb the resonance on 15 or 10 meters. The wires must be pulled tight, and they must not touch the metal rings on the standoff insulators.

The element ends are secured as shown in Fig. 4(b). Crimp the wire slightly, as shown, after sliding a plastic washer of at least 1½ inches diameter around it to prevent short-circuiting to the standoff ring. Leave about 10 or 12 inches of wire past the standoff for pruning purposes.

When trimming the elements, it will be necessary to raise and lower the antenna, since both the bottom and top elements must be cut to the same length. The final length will depend, to some extent, on how close the antenna is to trees and other obstructions. (The antenna should be located so that it cannot fall on utility lines!)

Theoretical element lengths (for each side of the dipole) are given in Table 1 as a function of frequency on 10 and 15 meters. At W1GV/4, the elements were trimmed for 21.100 and 28.500 MHz, and the lengths turned out to be about an inch shorter than the theoretical values on both bands. This was probably because of the abundant foliage on the property.

If you find that the resonant lengths appear nowhere near the values given in Table 1, first check to be sure that there are no short circuits to the main element. If there are none, you might have antenna currents on the feedline.

Decoupling the Line

Since this is an unbalanced antenna, meaning it is not symmetrical with respect to the feedline, it is possible that there may be rf currents on the shield of the coax. This is especially likely if the feedline happens to be a multiple of an electrical half wavelength on the operating frequency.

To decouple the line, the first thing to do is make certain that the length of the line is as far away from resonance as possible on all three bands simultaneously. Fig. 5 shows some of the best lengths, as well as those lengths that should be avoided. (Note that a feedline length of 66 feet is especially bad since it is resonant on all three bands!)

If this technique does not solve the problem, then you will have to install a choke in the line. To do this, simply wind the coax about 20 times around a piece of 2-inch o.d. plastic pipe, securing the coil in place with electrical tape. The choke should be placed at the

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point where the feedline enters the base of the antenna. After the choke has been wound, the remaining length of line to the rig should be nonresonant, as shown by Fig. 5.

A choke coil should be required only if high power is used, since the probability of getting rf in the shack increases with the power output of the transmitter.

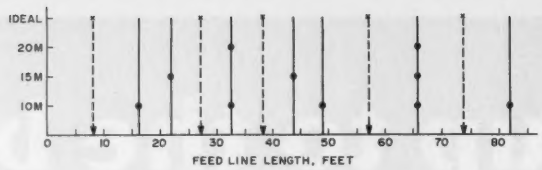

Fig. 5. Feedline resonant lengths are shown by dots and solid lines; these lengths should be avoided. Ideal lengths for a 20-, 15-, and 10-meter feedline are shown by an X with a dotted line. Resonant frequencies chosen for this chart are 14.175, 21.225, and 28.500 MHz, representing an approximate median for each band.

Frequency (MHz)	Element Length
21.000	11'2"
21.100	11'1"
21.200	11'0"
21.300	11'0"
21.400	10'11"
28.000	8'4"
28.250	8'3"
28.500	8'2"
28.750	8'2"
29.000	8'1"
29.250	8'0"
29.500	7'11"

Table 1. Theoretical resonant lengths for each side of a dipole antenna as a function of frequency. These lengths are approximate because of possible capacitive loading effects from nearby objects. Lengths are to the nearest inch. These values are measured from the feedpoint connection along the wire to the end of the element.

Performance

Using only 10 Watts output, many contacts have been made on all three bands. The low-angle radiation of this antenna appears to be exceptional, which is to be expected of a vertical dipole. The current loop is elevated about 17 feet above ground; this helps reduce absorption by nearby obstructions.

Particularly on 10 meters, where very little power is needed to produce DX, several European countries have been worked, often when competing against stations using yagis or quads and much more power.

The swr at resonance is better than 2 on all bands. It gets up to about 4 at the top end of 10 meters, since I adjusted it for 28.500 MHz. No matching network has been necessary to obtain proper transmitter tuning in normal operation.

Adding More Bands

It should not be difficult to add elements for the new bands at 18 and 24 MHz once they are opened for amateur use. These elements could simply be placed in parallel with the other three antennas.

There appears to be some possibility that, by adding enough elements of progressive lengths in parallel, it might be possible to build a broadband antenna capable of continuous coverage between two set frequencies. There are some structural problems involved with this, but I am presently working on the idea. If the results are good, I will present them in a future article. ■

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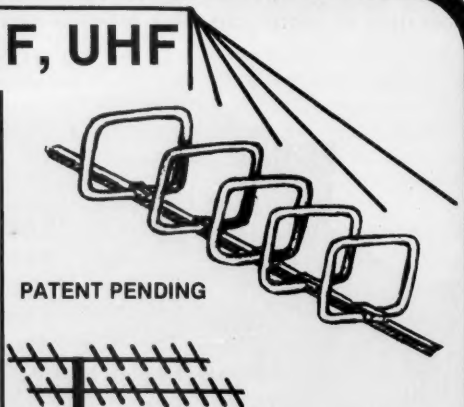

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The Campbell J

—a little antenna that "can"

Carlton Moseley W4YVY
1612 Colony Drive
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The Campbell Soup can antenna is a variation of the familiar J antenna. Four advantages of the soup can antenna are: (1) its unique construction uses many parts from around the house, (2) it can come apart for portable operation and storage, (3) the matching section is unbalanced to match coaxial feedlines, and (4) the matching section has immunity to detuning by nearby objects. Like the J antenna, the soup can antenna gives 3 dB gain over a ¼-wavelength whip because it uses a ½-wavelength radiator.

Background

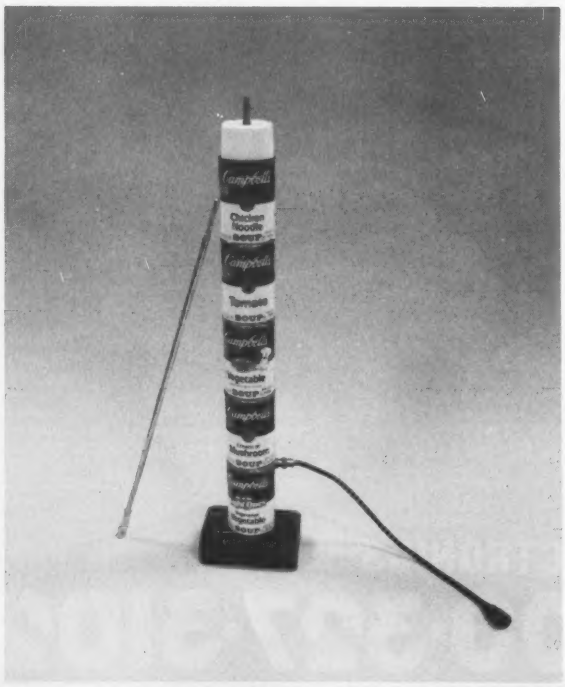
In a J antenna the bottom ¼ wavelength is a parallel transmission line used for matching. This matching section is shorted together at the bottom to give a zero impedance. Then, due to the transformation of a ¼-wavelength transmission line, the top of this ¼-wavelength matching section has a very high impedance. This very high impedance matches the impedance of an endfed ½-wavelength antenna. By tapping up on the ¼-wavelength matching section, a point can be found for the proper impedance match for the feedline being used.

The Campbell Soup can antenna, like the J antenna, uses a ¼-wavelength matching section, but in the Campbell Soup can antenna, the matching section is a coaxial line. The bottom of the soup can coaxial matching section is shorted together to give a zero impedance. Then ¼ wavelength above the zero impedance is, once again, the very high impedance needed to match an endfed ½-wavelength antenna.

Because of the coaxial design, this matching section can be fed with coaxial line without upsetting a balanced condition. Also, being coaxial, if metal objects are near the matching section, they will not upset the matching section operation.

Construction

Both ends are cut out of 3 of the Campbell Soup cans. These will be used in the middle of the coaxial matching section. For the top can of the coaxial matching section, one end is completely removed and the other end is cut out except for a ¼-inch-wide lip.



Two-meter soup can antenna.

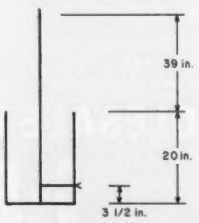


Fig. 1. Two-meter soup can antenna dimensions.

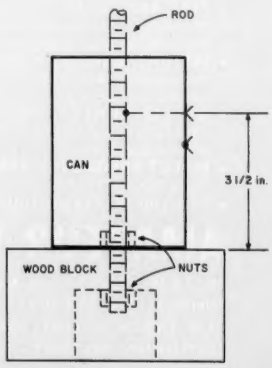


Fig. 2.

Later this lip will be the support for the plastic spray can top. For the bottom can, one end is completely removed and the other end has a hole cut in it to just pass the 5/16-inch threaded rod.

The wooden block should have a hole bored through it that is just big enough to pass the 5/16-inch threaded rod. The bottom of the block should have a larger hole countersunk in it to hold a nut and washer.

The bottom soup can is mounted on the wooden block using the threaded rod. The soup can is turned so that the end with the small hole is next to the wooden block. A nut and washer in the soup can and another nut and washer in the countersunk hole of the block will hold the items together. The rod should not extend below the block so that the block can sit on a surface and not scratch it.

A coax chassis connector is mounted on the side of the bottom soup can about 3½ inches from the bottom. The center conductor of the coax connector is attached to the threaded rod 3½ inches from the bottom of the soup can. It can be soldered, but a convenient method is to wrap a wire around the rod and hold it in place between two nuts and washers.

MATERIALS REQUIRED

- 5 Campbell Soup cans (or any other can 4 inches tall and about 2-1/2 inches or less in diameter)
- 1 5/16-inch threaded rod, 24 inches long (available at most hardware stores)
- 6 nuts for the 5/16-inch threaded rod
- 6 washers (use with the 6 nuts if desired)
- 1 adjustable replacement automobile antenna that will fit over the 5/16-inch threaded rod (the rod or antenna size may be varied to get a combination that will fit together)
- 1 two by four wood block, 5 inches long (this block size may be varied to suit the builder's needs just as long as the block is large enough to support the soup cans)
- 1 coax chassis connector (BNC type or SO-239)
- 1 plastic spray can top approximately 2-7/16 inches in diameter that will just fit inside an empty soup can (see text)

The remaining 4 soup cans are soldered together with the top soup can on one end with the lip away from the other cans. Next the 4 soup cans are soldered to the bottom soup can so that the lip of the top soup can is on top.

The top of the soup cans and the top of the threaded rod must be held rigid yet be insulated from each other. The plastic spray can top is used for this. A hole is cut in the spray can top so it will just slide over the threaded rod and then rest on the lip of the top soup can. The plastic spray can top can be held in place between two nuts and washers or, better yet, by one nut and washer screwed down tight. A piece of sheet plastic or thin wood will also work as an insulator and support.

Finally, the replacement automobile antenna is mounted on top of the threaded rod. Most replacement auto antennas designed for stud mounting have setscrews that will hold them in place.

Adjustments

The only adjustment is to adjust the length of the auto antenna. A length of 39 inches is needed as measured from the top of the top soup can to the top of the auto antenna. ■

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SP-120 EXTERNAL SPEAKER		41.50
AT-130 ANTENNA TUNER FOR TS-130	144.95	138.50
MB-100 MOBILE BRACKET FOR TS-130		29.50
PS-20 MOBILE SUPPLY FOR TS-130 13.8V 20AMPS	144.95	138.50
R-1000 COMM RCVR DIGITAL DISPLAY 200KHZ-30MHZ	499.95	449.50
R-600 SHORTWAVE RCVR W/O CLOCK AND TIMER	399.95	359.50
TL-922A LINEAR 160-15 METER LINEAR AMP 2 KW PEP	1229.95	1106.50
SM-220 STATION MONITOR 10MHZ SCOPE	399.95	339.50
YG-455C 500 HZ CW FILTER FOR TS-830 (455 IF)		95.90
YK-88CN 270 HZ CW FILTER	113.95	109.50
YK-88C 500HZ CW FILTER TS-830/530/130(8.83 IF)		62.50
YK-88CN 270 HZ CW FILTER		62.50
YK-88SN 2.4KHZ SSB FILTER FOR TS-530/130		62.50
MC-30S 30K OHM HAND MIC		29.50
MC-35S 50K OHM HAND MIC		29.50
MC-50 HI-Z IMPEADENCE DESK MIC 4 PIN PLUG		47.50
PC-1 PHONE PATCH		62.50
SM-8 DESK MIC	103.50	99.50
MC-10 DIGITAL COMPUTERIZED WORLD CLOCK	103.50	99.50
HS-5 DELUXE HEADSET		41.50
MS-6 LIGHT WEIGHT HEADPHONES		19.50
TS-660 15/10/6 MTR XCVR DIGITAL SOLID STATE 10W	849.95	799.50
VOX-4 VOX/SPEECH PROCESSOR		54.50
YK-88A FILTER 6 KHZ		49.50
FA-4 FAN FOR TS-130S		19.50
MC-60A DYNAMIC BASE MIC DELUXE 4 PIN		49.90
MC-60BM DYNAMIC BASE MIC DELUXE 8 PIN		54.50
RD-20 DUMMY LOAD 50W INT 20W CONTINUOUS		19.50
VFO-120 REMOTE VFO FOR TS-130	144.95	138.50
KPS-21 BASE STA 12VDC SUPPLY 21AMP INT	124.95	114.50
SP-100 EXTERNAL SPEAKER FOR R-1000/R-600		47.50
SP-40 COMPACT MOBILE SPEAKER		25.90
MC-48 16 KEY AUTOTUN MIC UP/DOWN BUTTONS		49.90
KB-1 FLYWHEEL-EFFECT TUNING KNOB FOR TS830/830		17.50
SB-8 SHORTWAVE PAN DISPLAY MODULE FOR TS830/820/180		79.50
SB-5 SM-220 PAN DISPLAY MODULE FOR TS820 SERIES		79.50
TS-930S W/AT ALL BAND DUAL VFO MEM ANT TUNER	1799.00	1679.50
TS-930S W/O ABOVE WITHOUT TUNER	1599.00	1479.50
AT-930 AUTOMATIC ANT TUNER FOR TS930S	199.95	179.90
SP-930 EXTERNAL SPKR WITH AUDIO FILTERS		79.50
YK-455C-1 500 HZ CW FILTER FOR 930S		94.50
YG-455CN-1 250 HZ CW FILTER FOR 930S	119.95	114.50
YK-88C-1 500 HZ CW FILTER 8.83 IF FOR 930S		69.50
YK-88N-1 400HZ AM FILTER FOR TS930S		59.90

KENWOOD VHF

	REGULAR	SALE
TR-7850 2MTR FM 40 WATTS 15 MEM PRIORITY	449.95	399.50
KPS-1 AC SUPPLY FOR TR-7800 TR-8400 12VDC 7 AMP		94.50
KPS-12 AC SUPPLY FOR TR-7850 12 VDC 12 AMPS		94.50
TR-9130/T 2MTR SSB/CW/FM SCAN MEMORY 25 WATTS	549.95	498.50
TR-9000 2MTR MULTIMODE W/O TOUCH TONE MIC	529.95	480.50
SP-120 EXTERNAL SPKR FOR TR-9000/9130		41.50
SO-9 MEMORY BACK UP POWER SUPPLY FOR TR-9000		42.50
TR-7730 2MTR FM 25W 5 MEM SCAN 10 WATTS FM	499.95	449.50
TR-7730/T COMPACT 25W 2 MTR 5 MEM SCAN TTMIC	349.95	324.50
MC-46 16 KEY TOUCH TONE MIC		49.50
TR-2500 2 MTR FM HAND-HELD	329.95	307.90
ST-2 BASE SUPPLY AND CHARGER FOR 2500		89.50
MB-1 MOBILE SUPPLY CHARGER FOR 2500		42.50
PB-25 NI-CD BATTERY PACK		34.50
SMC-25 SPEAKER MIC FOR 2500		34.50
LH-2 DELUXE LEATHER CASE FOR 2500		37.50
BH-2 BELT HOOK FOR TH-2500		5.50
WR-1 WRIST STRAP FOR TR-2500		2.50
BH-1 BATTERY CASE FOR TH-2500		5.50
VB-2530 25W RF AMP FOR TR-2500	99.95	94.50
BC-5 MOBILE QUICK CHARGER FOR TR-2500		39.50
TU-1 PROGRAMABLE CTCSS DECODER DIP 1W		34.50
TR-9500 70CH SSB/CW/FM XCIEVER 10WTTS	649.95	588.50
PB-23H 490MAH NI-CD BATT FOR TR2500		39.50

FAST SERVICE

MFJ

	REGULAR	SALE
989 RCVR PREAMP AND PRESELECTOR 1.6-30 MHZ		89.50
1040 RCVR PRESELECTOR 1.8-54MHZ MOSFET PREAMP		99.50
931 RCVR ANT TUNER 1.4-30MHZ DUAL INPUT		99.50
5289 RF SPEECH PROCESSOR VU METER	119.95	115.50
434 PHONE PATCH WITH VU METER		99.50
321 SATELLITE CONVERTER W/PREAMP		99.50
312 POLICE/FIRE/WEATHERBAND CONVERTER		39.50
308 SHORTWAVE CONVERTER 8 BAND TO AM RADIO		39.50
262 50 OHM LOAD 1KW AIR COOLED		49.50
260 AS ABOVE 300 WATTS		34.50
250 BATTERY CHGR 20W DUMMY LOAD		29.50
812 SWR/WATT METER 14-170 MHZ		29.50
814 HF WATTMETER 2KW READS SWR DIRECTLY		49.50
102 12 HOUR DIGITAL CLOCK		32.50
200BX CRYSTAL CALIBRATOR		29.50
CPO-SSB CRYSTAL PRACTICE OSCILLATOR		19.50
202 RF NOISE BRIDGE		54.50
1107 8 SOCKET RFI FILTERED POWER STRIP		79.50
1106 12 SOCKETS ONE FILTER FOR ALL		59.50

MFJ FILTERS

	REGULAR	SALE
7529 DUAL TUNABLE SSB/CW ACTIVE FILTER		89.50
721 SUPER CW/SSB FILTER 2 WATT AMP		39.50
720 DELUXE SUPER CW FILTER		39.50
722 CW/SSB FILTER SELECTABLE BANDWIDTH/NOTCH		69.50
722 AS ABOVE BUT FOR CW ONLY		49.50
752 SSB/AM/FM COMMERCIAL BAND FILTER 2 WT AMP		49.50
751 SSB/CW ACTIVE TUNABLE FILTER SIB ENHANCER		69.50

MFJ KEYERS

	REGULAR	SALE
406 DELUXE KEYER DOT AND DASH MEMORY		69.50
410 CURTIS KEYER PLUS CODE GENERATOR	129.95	121.50
481 BRANDMASTER MEMEORY KEYER 2 50 CH MSGS		89.50
484 AS ABOVE UP TO 12 MSGS UP TO 100 CH MSGS	139.95	130.50
496 SUPER KEYBOARD II/256 CH BUFFER & MEM	339.95	279.50
53 MFK PLUS IN MODULE FOR 496		39.50
54 LOGGER KEYER PLUS IN MODULE		49.50
61 CLOCK MODULE FOR 496		29.50
1200 CW COMPUTER INTERFACE		69.50

MFJ ANTENNA TUNERS

	REGULAR	SALE
989 3KW/ROLLER INDUCTOR/300W LOAD/MTR/BALUN	319.95	263.50
949E 300W TUNER/SWR WATTMTR/LOAD/ANT SW/BALUN	139.95	130.50
941E 300W TUNER/SWR WATTMTR/ANT SW/BALUN		89.50
944 300W TUNER/ANTENNA SWITCH		79.50
901 VERSA TUNER/COAX/SM WIRES/BALANCE LINES		84.50

JW MILLER

	REGULAR	SALE
AT-2500 2.5 KW AUTO ANT TNR 3-30MHZ PWR/SWR MTR	872.50	698.50
CNA-1001 500W AUTO ANT TNR 80/10MTRS PWR.SWR MTR	461.25	369.50
CN-2009 160/2 TWO MTRS DUAL NEEDLE SWR/PWR MTR	195.75	124.50
CN-7209 LARGE METER FACE VERSION OF ABOVE	218.75	175.50
CN-430 140-450 MHZ DUAL NEEDLE SWR/PWR METER	183.75	147.50
CS-201 2 POS COAXIAL SW 2.5KW 300 MHZ	29.00	23.50
CS-401 4 POSITION COAX SWITCH AS ABOVE	89.25	68.50

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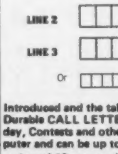

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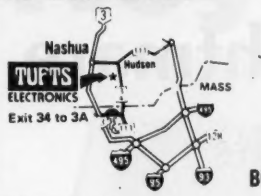
HG-5288	52 FT SELF SUPPORT 9 SQ FT 50 MPH	1095.00	958.50
HG-50HT2	50 FT SIDE SUPPORT 6 SQ FT 50 MPH	913.00	805.50
HG-35HT2	35 FT SIDE SUPPORT 9.5 SQ FT 50 MPH	661.00	583.50
HG-37HD	37 FT SELF SUPPORT 9 SQ FT 50 MPH	777.00	685.50
HG-54HD	54 FT SELF SUPPORT 16 SQ FT 60 MPH	1818.00	1499.50
HG-70HD	70 FT SELF SUPPORT 16 SQ FT 60 MPH	2850.00	2299.50
HG-53HT2	53 FT SIDE SUPPORT 8.5 SQ FT 50 MPH	898.00	795.50
121B	HG-TST THRUST BEARING WITH SLEEVE	43.00	43.50
122	HG-CDA COAX ARM FOR TOWERS ONE PER SECT		13.50
123	ELECTRINC MENCH FOR 32BS/54HD/70HD TOWERS	650.00	535.50
124	HG-RMC REMOTE CONTROL FOR ELECTRIC MENCH	521.00	429.50
HG-HT2-10	BUYING KIT FOR 33HT2 TOWER	181.00	132.50
HG-HT2-20	BUYING KIT FOR 33HT2/50HT2 KTOWERS	150.00	131.50
HG-5	5FT STEEL MAST 2"OD .120 WALL		49.50
HG-10	10FT STEEL MAST 2"OD .120 WALL		74.50
HG-15	15FT STEEL MAST 2"OD .120 WALL	110.00	102.50
HG-MA	MAST ADAPTER FOR HT-2 TOWERS		27.50
HG-TDA	TILT OVER GIN POLE FOR 88 TOWERS	300.00	247.50



TELEX HEADSETS

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PRO-COMM 300 LST MST BOOM MIC HEADSET HI/LO IMP		89.50
PRO-COMM 200 DUAL MUFF BOOM MIC HEADSET HI/LO IMP		99.50
FS-1 FOOT SWITCH FOR PROCOMM HEADSETS		28.50
HB-1 HANDSWITCH FOR PROCOMM HEADSETS		15.50
PC-100 8-200 OHMS HEADSET		16.50
SHL-410 2000 OHM HEADSET		14.50
C-1210 DUAL MUFF HEADSET 3-20 OHMS		29.50
C-1320 DUAL MUFF HEADSET 3-20 OHMS		44.50
CS-7 DUAL MUFF 600 OHM HEADSET		49.50
MTC-2 LGHT/MST MAGNETIC DRIVER MDST 3-20 OHM		24.50

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	REGULAR	SALE
TH3JRS 3 ELEMENT TRI-BAND 750WATT PEP	231.95	173.90
HB-2B HY-GUARD 2 ELEMENT GUARD TRI-BANDER	389.95	275.90
TH5MK2S 5 ELEMENT TRI-BANDER	489.95	324.50
TH3MK3S 3 ELEMENT TRI-BANDER	319.95	232.50
TH7DXS SUPER THUNDERBIRD 6 ELEMENTS TRI-BAND	599.95	398.50
TH2MK3S 2 ELEMENTS TRI-BANDER	199.95	149.50
DB10/15A6 3 ELEMENT 10-15 METERS BEAM	218.95	164.50
203BA6 3 ELEMENT 20 METER BEAM	194.95	146.50
153BA6 3 ELEMENT 15 METER BEAM	109.95	90.50
103BA6 3 ELEMENT 10 METER BEAM		79.50
105BA6 5 ELEMENT LONG JOHN 10 METER BEAM	169.95	127.50
155BA6 5 ELEMENT LONG JOHN 15 METER BEAM	259.95	189.50
205BA6 5 ELEMENT LONG JOHN 20 MTR BEAM	434.95	307.50
204BA6 4 ELEMENT 20 MTR BEAM	332.95	242.50
402BWA 2 ELEMENT 40 METER BEAM	287.95	209.50
18TD PORTABLE TAPE DIPOLE 10 THRU 80 METERS	134.95	111.90
280D TRAP DOUBLET 40 AND 80 METERS		69.50
580D TRAP DOUBLET 10 THRU 80 METERS	144.95	115.90
18HTS HY-TOWER 10 THRU 80 METER VERTICAL	499.95	382.50
14RMB ROOF MTG KIT FOR VERTICALS		41.50
12AVQS TRAP VERTICAL 10 THRU 20 METERS		85.50
14AVQ/WBS TRAP VERTICAL 10 THRU 40 METERS		79.50
18AVT/WBS TRAP VERTICAL 80 THRU 10 METERS	129.95	107.50
TH6/TH7 UPDATE KIT FOR TH6DXX TO TH7DX	199.95	149.50

HY-GAIN ROTORS

	REGULAR	SALE
HDR 300 HVY DUTY DIGITAL HANDLES 25 SQFT 300LBS	559.95	448.90
T2X HVY DUTY W/MEDGE BRAKE 20 SQFT IN TOWER	334.95	250.50
HAM IV METERED W/MEDGE BRAKE 15 SQFT IN TOWER	268.00	211.50
CD-45 II METERED ROTOR 8.5 SQ FT IN TOWER	164.95	122.50
AR-40 SOLID STATE BELL 2 SQ FT SILENT OPERATION	124.95	89.50
AR22XL AUTOMATIC BELL 3 SQ FT	104.95	72.50
CONTROL BOX FOR T2X	157.00	125.50
CONTROL BOX FOR HAM IV OR CD45	134.95	110.50
CONTROL BOX FOR AR40		53.50
CONTROL BOX FOR AR22XL		49.50
SOUTH CENTER SCALE KIT FOR T2X HAMIV CD45		6.50
LOWER MAST MOUNT KIT FOR T2X/HAM IV	67.00	46.50
LOWER MAST LOWER MAST SUPPORT FOR CD45 II		24.50

TEN-TEC INC

	REGULAR	SALE
ARGONAUT QRP XCVR SSB/ CW 80-10 METERS	469.00	399.50
ARGOSY SSB/CW 80-10 METERS	579.00	531.50
OMNI DIGITAL 160-10 METERS XCVR	1289.00	1079.50
DELTA SSB/CW 160-10 XCVR	849.00	749.50
227 ANTENNA TUNER	89.00	87.50
229 ANT TUNER/ SWR BRIDGE	110.00	104.50
225 SUPPLY 110/230VAC FOR ARGOSY	129.95	125.50
255 DELUXE SUPPLY 110/230VAC FOR XCVRS	199.00	186.50
HERCULES 1 KW LINEAR SLD STATE&SUPPLY	1895.00	1689.50
234 SPEECH PROCESSOR	139.95	130.50
214 ELECTRET MIC FOR 234	45.00	42.50
243 REMOTE VFO FOR OMNI	189.95	177.50
283 REMOTE VFO FOR DELT	189.95	184.50
209 300 WATT DUMMY LOAD	26.00	24.50
445 ULTIMATIC DUAL PADDLE KEYER	85.00	81.50
470 SIMBLE PADDLE KEYER	39.00	37.50
208A NOTCH CW FILTER FOR ARGONAUT	89.00	87.50
OMNIC/HERCULES SPECIAL PACKAGE	3625.00	2599.50
229 2 KW ANTENNA TUNER W/SWR BRIDGE 3NEW	279.00	259.50

YAESU ELECTRONICS

	REGULAR	SALE
FT-902DM 160-10 METER XCVR W/MEMORY AND KEYER	1535.00	1299.50
FV-901DM SYNN VFO	415.00	349.50
FC-902 ANTENNA TUNER	199.00	189.50
SP-901P SPEAKER PHONE PATCH		76.50
SP-901 REMOTE SPEAKER		35.50
FTV-901R TRANSVERTER W/2MTR MODULE	389.00	339.50
6MTR MODULE MODULE FOR FTV-901R	110.00	107.50
70CM MODULE MODULE FOR FTV-901R	295.00	239.50
YO-901P MONITOR SCOPE W/PANDAPTER	815.00	454.50
YH-901 CW RITY READER (VIDEO MONITOR EXTRA)	730.00	643.50
YK-901 ASCII KEYBOARD	175.00	163.50
FT-107M 160/10 MTR/BLD ST/DIBITAL/MEMORY/AC-DC	1149.00	999.50
FP-107B EXTERNAL AC SUPPLY FOR 107	145.00	139.50
FP-107 INTERNAL AC SUPPLY FOR FT-107	139.00	131.50
FC-107 ANTENNA TUNER	150.00	140.50
FV-107 EXTERNAL VFO	150.00	140.50
SP-107P SPEAKER PHONE PATCH		65.50
SP-107 EXTERNAL SPEAKER		37.50
FTV-107R TRANSVERTER W/2 MTR MODULE	304.00	269.50
FT-101ZD 160-10 MTR XCVR DIGITAL APP WARC	935.00	829.50
FV-101Z EXTERNAL VFO	175.00	164.50
SC-101ZD DC CONVERTER		59.50
AM-101Z AM UNIT FOR FT101ZD		27.50
FM-101Z FM UNIT FOR FT101ZD		34.50
FT-707 80-10 MTR COMPACT XCVR FOR MOBILE/BASE	810.00	729.50
FV-707DM MEMORY/SCAN VFO	279.00	256.50
FP-707 AC POWER SUPPLY	142.00	132.50
FC-707 ANTENNA TUNER	129.00	119.50
MMB-2 MOBILE BRACKET		21.50
XFB.9HC 600 HZ FILTER FOR HF RIGS		45.50
XFB.9HCN 250 HZ CW FILTER FOR HF RIGS		49.50
XFB.9B AM FILTER FOR HF RIGS		45.50
YH-77 LIGHTWEIGHT HEADSET FOR COMM EQUIP		24.50
DTR-24D QUARTZ WORLD CLOCK	49.00	47.50
YS-200 200W SWR/WATTMETER 800D TO 150MHZ		79.50
YS-2000 2000W SWR/WATTMETER 800D TO 60MHZ		139.50
YP-150I DUMMY LOAD WATTMETER	135.95	126.50
YC-1000L LOGGING DATA PROCESSOR	1800.00	1371.50
FA-9 COOLING FAN		22.50
FRG-7700 DIGITAL SYNN VLF TO 30MHZ RCVR	349.00	499.50
MU-7700 MEMORY UNIT	149.95	140.50
FRT-7700 ANTENNA TUNER		59.50
FF-5 VLF LOW PASS FILTER		20.50
DC-7700 DC ADAPTER KIT		8.50
FRV-7700 118-150 MHZ CONVERTER	149.00	140.50
YE-7A HAND MIC FT101ZD		17.50
YD-148 DESK MIC MI/LD FOR FT101ZD		32.50
YM-34 DESK MIC MI/LD FOR 107/707		31.50
YM-35 SCAN MIC 107/707		20.50
YM-36 HAND MIC 107/707		20.50
YM-37 HAND MIC 107/707		10.50
YM-38 DESK SCAN MIC 107/707		39.50
FT-ONE ALL BAND XCVR CPU GEN CVG RCVR KEYER ETC	2995.00	2495.50
XFB.9KC 600HZ 8 POLE FILTER FOR FT-ONE		49.50
XFB.9KCN 300 HZ 8 POLE FILTER FOR FT-ONE		49.50
XFB.9KA 6 KHZ 8 POLE AM FILTER FOR FT-ONE		49.50
XF10.7KC 800 HZ 6 POLE 3RD IF FILTER FOR FT-ONE		44.50
RAM UNIT MEMORY BACK-UP BOARD FOR FT-ONE	K	49.50
KY-ONE CURTIS 8044 KEYER UNIT FOR FT-ONE		49.50
DC-CABLE DC CABLE FOR FT-ONE		14.50
FV-101DM SYNN SCANNING MEMORY VFO FOR FT-101ZD	389.00	329.50
FT-180 HF SOLID STATE XTAL CONTROLLED XCVR	895.00	789.50
FT-102 160-10MTR HF XCIEVER 110/220VAC	1149.00	985.50
FV-102DM EXTERNAL VFO FOR FT-102 DIBITAL/MEMORY	329.00	289.50
SP-102 SPEAKER WITH AUDIO FILTER		59.50
SP-102P PHONE PATCH SPEAKER		49.50
FC-102 1.2KW ANT TUNER W/WATTMETER AND SWR	299.00	263.50
AM/FM-102 AM/FM UNIT		59.50
XFB.2HBH 1.8 KHZ SSB FILTER		40.50
XFB.2HC 600 HZ CW FILTER		40.50
XFB.2HCN 300 HZ CW FILTER		40.50
XF-455C 500 HZ CW FILTER		60.50
XF-455CN 270 HZ CW FILTER		60.50
MD-1B8 DESK MIC TONE CONTROL SCAN CONTROLS		49.50
MH-1B8 AS ABOVE HAN-HELD MIC		20.50

YAESU VHF/UHF

	REGULAR	SALE
FT-208R 2 MTR SYNN WALKIE LCD MEMORIES TTP SCAN	389.95	329.50
FNB-2 BATT PACK OF FT-208R		29.50
YH-24A SPEAKER MIC		29.50
NC-7 BASE CHARGER		59.50
NC-8 RAPID BASE CHARGER		99.50
PA-3 MOBILE ADAPTER CHARGER		39.50
LCC-8 LEATHER CASE		35.50
FT-290R ALL MODE 2 WATT 2MTR PORT/MOBILE XCVR	399.00	359.50
MC-11B WALL CHARGER		9.50
LCC-9D CARRY CASE		38.50
NICD NICAD C CELLS		30.50
FT-690R 2 MTR SYNN MULTI-MODE XCVR	529.00	469.50
FT-127RA 220 FM SYNN MEMORY SCANNING	479.00	422.50
FT-127 12 CHANNEL 220 FM XCVR	399.00	349.50
FT-480R SYNN ALL MODE 6 MTR XCVR	520.00	459.50
FT-790R 430-440 MHZ SYNN MULTI-MODE	788.00	699.50
FP-80 MATCHING SUPPLY 480/680/780		95.50
SC-1 STATION CONSOLE		199.50
FSP-1 REMOTE SPEAKER FOR MOBILE		31.50
FP-12 12 12VDC SUPPLY W/SPEAKER	135.00	129.50
YH-39 SCAN KEYBOARD MIC FOR 720		76.50
YH-98 TONE ENCODING MIC FOR 480		69.50
MMB-11 MOBILE BRACKET AND ADPATER FOR 290R		34.50
FL-2010 10 WATT AMP FOR 290R (FITS MMB-11)		99.50
FT-708R 70CM SYNN HANDHELD 440-450MHZ BATT&CHGR	359.00	329.50
FT-690R SIX METER SYNN PORTABLE MULTI-MODE	379.00	339.50
FT-230R 2 MTR 25WATTS SYNN LCD SCAN & MEMORY	389.00	329.50

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QSA-6 SIX METER VERSION OF ABOVE		47.50
PM-1 2 MTR PREAMP MODULE 20W MAX NOISE FIG		19.50
30PB 10 METER PREAMP 20W MAX NOISE FIGURE		25.50
50 PB SIX MTR PREAMP AS ABOVE		23.50
144PB 2 MTR PREAMP AS ABOVE		23.50
220PB 220 MHZ VERSION PREAMP AS ABOVE		23.50
432PK 432 VERSION PREAMP AS ABOVE		37.50
432PL 1 DB MAX NOISE FIG 432 MHZ ORDER BY FREQ		53.50

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VIC-20 HOME COMPUTER 4K GRAPHICS/COLOR BASIC	299.95	259.50
VIC-1530 DATASETTE TPE RECORDER FOR VIC-20	75.00	69.50
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Avoid an Electrical Nightmare

—sidestepping ground faults

A R. Taylor W5OS had a very interesting article in the February, 1981, issue of *73* titled, "Stalking the Elusive Ground Fault." He went through anxiety trying to correct the situation. What was the situation? Simply, he had extra-high voltage on one side of his three-wire 240-volt system and very low voltage under load on the other side.

The high-voltage side burned out his fluorescent light (in flames, actually) and burned out the transformer in an electric clock-radio. The other side of the 120-ground-120-volt system had such a low voltage under load that his freezer and refrigerator would not run. However, with those two devices pulled off the circuit, his lights on that 120-volt side would work.

What happened is not common, but happens occasionally when aluminum wire is used between the power-line pole transformer and the house circuit. It happened to me after I moved into a newly-constructed home with a brand-new service connection. *It is potentially dangerous!*

The symptoms in my case were the sudden brightening of reading lights which when turned off and then on again would work satisfactorily. A similar symptom occurred in another room with sudden tremendous brilliance of the lights and increased intensity of the TV picture. A transformer in the house heating system burned up and was replaced under warranty. At the time, it was thought it was a defective transformer since it was a brand-new installation.

The problem was definitely intermittent and, of course, did not show on a recording voltmeter that the power company put on the house line for 24 hours; those tests never work when you want them to. At times, I could measure *220* volts on one side of a 120-volt circuit and practically zero on the other side, but it would become normal if any load were changed.

Let's stop a minute and see what is happening; it definitely is a ground fault, whatever that means at this point in the story.

Fig. 1(a) shows a 240-volt, three-wire system with a 100-Watt lamp on one side of a 120-volt line and a 1000-Watt toaster on the other side of the line. From Ohm's Law we find that the resistance of the lamp and toaster using 120 volts is: $(R = E^2/P)$ $R_{lamp} = 120^2/100 = 144$ Ohms; $R_{toaster} = 120^2/1000 = 14.4$ Ohms.

A ground fault occurs when the ground connection at the supply transformer opens—see Fig. 1(b). We still have our 240 volts, but it is across the light and toaster which are now in series. How much current flows through that series load? $I = E/(R_L + R_T) = 240/(144 + 14.4) = 1.52$ Amperes.

More important, however, is the voltage across the lamp and the toaster, individually. $E_L = I_L \times R_L = 1.52 \times 144 = 218.9$ volts; $E_T = I_T \times R_T = 1.52 \times 14.4 = 21.9$ volts.

Now do you see why the lights get so bright and the toaster appears not to be working? Do you see why the fluorescent light burned up and the freezer would not work?

After I performed the above arithmetic, I knew why a filter capacitor in the high-voltage power supply of my TS-520 shorted and had to be replaced as well as all the other phenomena that occurred. Incidentally, I now have the TS-520 on its 240-volt connection across the 240-volt line instead of using 120 volts.

The situation came to a head one day when the fault continued regardless of switching loads on or off. A call to the utility company brought a quick response—a crew of three men. After all, if a burned-down house can be traced to a fault by the power company, it creates a problem for them. Actually they really do want to keep satisfied customers.

The fault continued long enough for them to test and assure themselves that it was not a house wiring problem; then the fault magically disappeared. They knew what to do, though. They climbed the utility pole upon which the 2700-to-240-volt transformer was mounted and inspected all the connections from it to the three-wire service line.

Sure enough, the ground connection was unsatisfac-

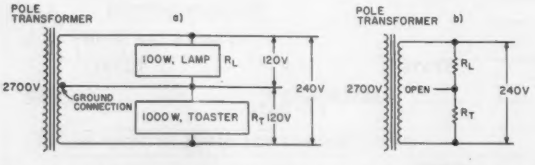

Fig. 1. (a) 120-volt load distribution. (b) Results of open ground connection on 120-volt circuits.

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Delete errors by backspacing.

A meter gives buffer remaining or speed. Two characters before buffer full the meter lights up red and the sidetone changes pitch.

Four programmable message memories (2 for 494) give a total of 256 characters (30 for 494). Each message starts after one ends for no wasted memory. Delete errors by backspacing.

To use the **automatic messages,** type your call into message A. Then by pressing the CQ button you send CQ CQ DE (message A).

The other automatic messages work the same way: CQ TEST DE, DE, QRZ.

Special keys for KN, SK, BT, AS, AA and AR.

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MODE 2 & 3 (RTTY): BAUDOT & ASCII

5 level Baudot is transmitted at 60 WPM. Both RTTY and CW ID are provided.

Carriage return, line feed, and "LTRS" are sent automatically on the first space after 63 characters on a line. This gives unbroken words at the receiving end and frees you from sending the carriage return. After 70 characters the function is initiated without a space.

All up and down shift is done automatically. A downshift occurs on every space to quickly clear garbled reception.

The buffer, programmable and automatic messages, backspace delete and PTT control (keys your rig) are included.

The ASCII mode includes all the features of Baudot. Transmission speed is 110 baud. Both upper and lower case are generated.

MODE 4: MEMORY KEYER

Plug in a paddle to use it as a deluxe full feature memory keyer with automatic and programmable memories, iambic operation, dot-dash memories, and all the features of the CW mode.

MODE 5: MORSE CODE PRACTICE

There are two Morse code practice modes. Mode 1: random length groups of random characters. Mode 2: pseudo random 5 character groups in 8 separate repeatable lists (with answers).

Insert space between characters and groups to form high speed characters at slower speed for easy character recognition.

Select alphabetic or alphanumeric plus punctuation. You can even pause and then resume.

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tory. They installed a new connector and assured me no additional problems would occur. Over two years have gone by and none has. Since the three-wire service to the house is aluminum wire which is prone to produce a high-resistance corrosion layer on its outer surface, you can be sure that I will have that connection checked at the slightest indication of a ground fault occurring again.

A number of you with new homes will say, "I have a ground-fault circuit tester on my house switch panel." That will be true but, unfortunately, we are talking about two different things.

House wiring for each 120-volt circuit consists of three wires. A black insulated wire is described as "hot" since it is energized at all times. The white insulated wire conducts no electric current unless the circuit is connected, i.e., a switch is "on." The white wire is called "neutral." The third wire is the grounding wire and connects all the metal parts in the wiring system to earth through the cold-water piping or a pipe driven into the ground. Items grounded include metal outlet and switch boxes, metal conduit, metal cases of stoves, refrigerators, and washers. A three-prong appliance cord continues the grounding all the way to the outer shell of a test instrument or hand power tool. Any fault in such an appliance, as a loose wire or worn insulation touching its grounded metal frame, will cause a house fuse or circuit breaker to trip. Appliances or tools that do not have this protection are dangerous—you could get a shock if something should go wrong with the internal wiring.

Many homes have a Test button on the service panel which when pressed will open the circuit being tested, indicating that no ground fault exists.

Perhaps it would be better to describe the outside service problem as "an open ground return," and not a ground fault, although it is. However, know the difference!

It is worth repeating: An open ground return in a three-wire, 240-volt system will put unusually high voltages on certain loads of the house system which may cause them to overheat, burst into flames, and destroy your home. Be aware of the symptoms and cure. The total destruction at my home before correcting the problem was as follows: 1) power transformer in heating system, 2) smoke detector connected to house line, 3) high-voltage capacitor in TS-520, 4) power supply in garage door opener, 5) vertical linearity in TV set.

Those low voltages may be just as dangerous where refrigerator or washing machine motors are concerned. Insufficient voltage will prevent them from running, thus preventing them from producing a back emf to raise their effective impedance. They will present a low dc resistance to the line voltage, perhaps drawing abnormal current, heating up, bursting into flames, and who knows what then.

It makes me a little apprehensive when I go on a vacation. Have I disconnected *all* appliances? But can I? No, because I like to have programmed lights go on in various rooms at night to indicate occupancy. Probably those lights would burn out fast at 218.9 volts before any damage could be done. But what about the 120-volt smoke detector? Yes, and how about that little door-bell transformer nailed to the cellar ceiling floor beam: That's never turned off! ■

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Fine-Tune Your IC-280

—15-kHz step rate got you down?

The versatility, quality, and plain good looks of Icom's 2-meter equipment have made this line very popular. The IC-280 is the epitome of all these traits. One feature is the well-thought-out system used for tuning. By spinning one continuously detented knob, the operator is able to quickly scan from 143.90 through 148.11 MHz. When tuning, an optical chopper causes the microprocessor control chip to update the multiplexed digital readout and tunes the phase-locked loop with a digital coding. The phase-locked loop increments or decrements in 5-kHz steps except in the 146-to-148-MHz range. Here, it hits all the normal and tertiary repeater channels in 15-kHz steps.

In an area where the repeater density is not too high, it's been my experience that any and all frequencies in between the active repeater channels are fair game and are used frequently for simplex operation. It invariably seems that when I'm asked to go to a simplex frequency from a repeater, I'm always 5 kHz off with the IC-280.

To correct this problem, I found that I could modify the digital coding on the MHz lines from the microprocessor, IC7, to the PLL. This fools the microprocessor into thinking it's tuning 144-145 MHz in 5-kHz steps when the PLL actually sees 146-147-MHz frequencies. This is a reversible change and does not add any external switches or accessories that would distract from the clean looks of the IC-280.

The MHz data line logic from the microprocessor to the PLL is shown simplified in Fig. 1. It can be seen that the difference between 144-145-MHz data is the logic on lines B3 and C3.

I decided originally to use the circuit shown simplified in Fig. 2 to modify the data lines. By hard-wiring the transmitter in the 10-Watt mode, the HI-LOW button on the front panel becomes available for controlling the gate operation. In the normal position, B3 and C3 data would not change through the gates. When a high is placed on the switch, the exclusive OR gating will reverse the data levels on the two lines going to the PLL.

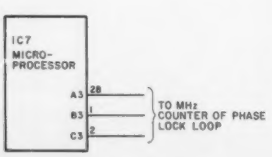
After spending several evenings experimenting, I found the parts required to interface a 4070 quad exclusive OR chip into the circuit were more than I wanted to use.

I finally decided that even with all the CMOS IC sophistication, a simple DPDT relay would do the same thing. I settled on a Potter and Brumfield type HPS microminiature DPDT relay. It measures only .41" × .81" × .41". Mine has a 24-volt coil but keys reliably with as little as 10 volts. Twelve-volt relays are available in this line. Using contact cement, I placed mine on the underside of the groundshield that covers IC3 on the PLL board. The relay pins extend out from under the cover by IC6. All connections are soldered directly to the relay pins. Fig. 3 shows the relay wiring. Solder the jumpers before cementing the relay can down.

Remove the gray wire from the main unit board printed circuit pad marked HI-LOW. Pull the wire back through the clear plastic spaghetti and reroute it for connection to the relay coil. This wire is from the HI-LOW switch. Ground the other side of the relay coil.

Jumper the HI-LOW solder pad to ground. This sets 10-Watt operation of the transmitter. With it left open, you would have constant 1-Watt operation.

Find connector J4 on the



	C3	B3	A3
143	0	0	1
144	0	1	0
145	0	1	1
146	1	0	0
147	1	0	1
148	1	1	0

Fig. 1.

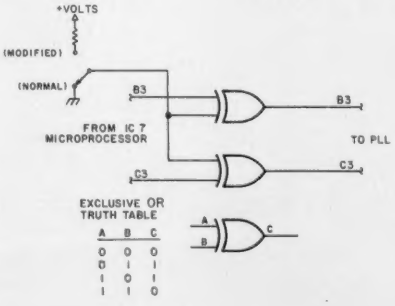


Fig. 2.

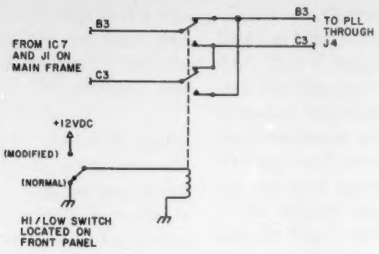


Fig. 3.

PLL board. The red and brown wires on this connector are B3 and C3 coming from J1 and the microprocessor in the remote head. Snip them, leaving enough wire on the J4 side to solder to the relay. They go through J4 to the PLL.

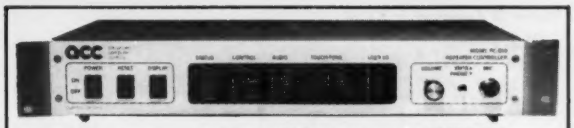
Extend the remaining red and brown wires from J1 a few inches and solder to their respective relay pins.

Remove the remote transceiver head, its cover, and the speaker. Find the open lug on the HI-LOW switch and solder a wire between it and the switched 12 volts on the power switch.

Dress and check all the wiring to the relay and reassemble the transceiver.

By pressing the HI-LOW switch to the LOW position, B3 and C3 lines are reversed. 144 on the display is actually 146. 145 is actually 147. The 100-, 10-, and 5-kHz digits are correct. Notice that 143 and 148 MHz remain unchanged. By releasing the HI-LOW button, normal operation is restored.

I no longer miss all that 146-147 simplex! ■



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11306	22	1.26	1.12	1.02
11307	24	1.41	1.25	1.14
11308	28	1.71	1.52	1.38
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11205	20	.27	.24	.21
11206	22	.30	.26	.23
11207	24	.33	.30	.25
11208	28	.38	.34	.29
11209	40	.53	.45	.40

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A Gem of an RIT

—customizing the receive on the SB-104

Two or three years ago I bought a new Heath SB-104, and after getting it all together found that I needed some sort of RIT feature. RIT (receiver incremental tuning) can be very helpful in a roundtable when one of the stations in the group is slightly off frequency and you need to tune in the station a little better. When this is done, however, the other station or stations will retune to you, and after a few rounds of this you find everyone has migrated several kilohertz away from the original frequency.

Or—and this is my situation—voice characteristics are such that the other station thinks you should sound a little higher or lower in frequency and the operator retunes slightly. The net effect is the same in both cases, and some means of effecting receiver fine-tuning without changing the transmit frequency is desirable if not necessary.

Heath offers a separate vfo (variable frequency oscillator) so one could get in the one unit the capability of changing a receive frequency without changing the transmit frequency, and be able to operate split frequency in the same band. Split operation is common enough in DXing and in some contests, but for general use it is just another control to manipulate. At first, I used a Kenwood separate vfo with my 104, and since it had built-in RIT, it was used almost exclusively. (For those interested in such a scheme, see my article, "The Heath/Kenwood Connection," *73 Magazine*, April, 1979.)

When a friend wanted my Kenwood vfo for his 520, I began to develop a more direct RIT system, one which could be integrated into the 104's vfo circuit and still not drastically alter the rig's appearance. In the experimenting, I found that not only could I get RIT, but that there was some "fallout" extending into a few other areas which are of interest to amateur operators.

Simple Simple RIT

Designed into the Heath 104 vfo is an LSB (lower sideband) shift system to keep the readout of the operating frequency from changing when going from upper to lower sideband. This is only a nicety since the 104 gives a totally corrected readout of frequency, computed from the various oscillators in the transceiver. LSB shift seems nothing but a carry-over from the days when—mechanical readouts of operating frequency making it necessary—the operator did not have to recalibrate when he changed sidebands on moving from one band to another.

After a little experimentation, I found that the LSB shift signal going into the vfo could be used for RIT. A switching diode is used in this circuit to effectively bring some added capacitance into circuit in the vfo, thereby changing the frequency by a small amount. The total change in frequency on the 104 was 1.9 kHz, and this meant about plus or minus 950 Hz, after

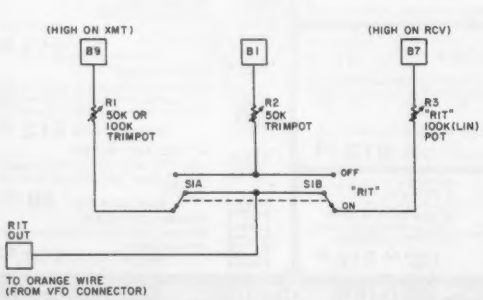

Fig. 1. Simple² RIT.

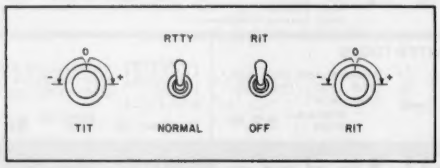

Fig. 2. Deluxe RIT.

the LSB shift cap in the vfo was adjusted so that this much swing could be obtained—quite enough for RIT purposes.

I thought about changing the diode for a varactor diode, etc., and getting more swing, but didn't consider it worthwhile. The vfo is stable, with no drift or warm-up miseries, so I felt it better left alone.

As a general rule, the simpler the circuitry needed to obtain the desired results, the better. So, if you will refer to Fig. 1, you can see the circuit for probably the simplest RIT a person could ever add to a rig. Simple squared! One RIT pot, two trimpots, and a switch!

First, the orange wire coming from the vfo to the LSB mode switch will need to be removed from the mode switch terminal and connected to the operating points of the DPDT switch. (One could even eliminate DPDT switch S1 if desired, since the transceive frequency can be obtained by flipping the mike switch to transmit, noting the readout frequency, then going back to receive and adjusting the RIT control to show the same frequency on the readout. Of course, then, R2, the center frequency adjustment, would not be necessary either. One could drill a hole in the front panel for the RIT pot, the control could be put in place of the VOX gain or delay pots, or it is even possible to replace the VOX delay control with a switch/potentiometer combination. This last option is probably the best method, all things considered, but the VOX delay control would then become a preset control located internally.)

The method selected for mounting the RIT control is up to the installer, of course, and there may be some other way one could mount it that would be even more practical than the one I've suggested.

(It's a shame that the boys at Heath didn't furnish RIT, but if enough people get the message that *all* the oriental dandies have RIT and everyone wants it, then maybe we'll see it come out on the next go-around.)

To adjust the two trimpots in Fig. 1, first swing the RIT pot (R3) from extreme to extreme (CW and CCW) to find the minimum and maximum frequencies. The difference between the two readings is the total swing. Then adjust the pot to midposition. Turn S1 to OFF so that R2 can also be adjusted to the same reading. Turn to ON and, with mike gain turned completely down, press the PTT (Push-To-Talk) button on the mike and adjust R1 for the same reading on the digital readout. This completes the adjustment. The simple[2] RIT is now ready to go. Terminal numbers B9, B1, and B7 correspond to board-socket pins of regulator board B.

Deluxe RIT/TIT RTTY Version

At my station, radioteletype also is used. The system is by Microlog, and to be able to use the 104 on RTTY, the receiver must be adjusted to receive 1.6 kHz lower than the transmit frequency. This is because the Microlog receiver is designed to filter and regenerate everything, CW and RTTY, at the CW sidetone frequency.

I could have used the auxiliary input on the Microlog to develop the signal and maintain operation when conditions were optimum, but I would lose the filtering for the whole system. On noisy HF bands you need all the filtering you can get, and the signal conditioning designed into the Microlog is practically unbeatable.

With the new RIT circuit, I could get only 0.9 kHz swing instead of the 1.6 kHz required. So I hit upon the scheme of shifting the transmit frequency by a certain amount and then the receive frequency could be as much as 1.9 kHz away. With 100-Hz accuracy on the frequency readout, I would have total control over the transmit frequency as well as the receive frequency. Now I had RIT and TIT (transmitter incremental tuning).

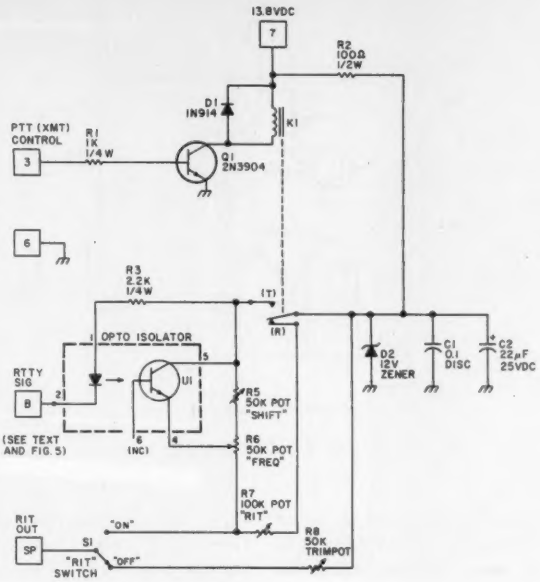

Fig. 3. Deluxe RIT circuit.

In Fig. 2, you can see the panel layout for a little box I picked up at the local Radio Shack which is 2" high by 6" wide by 4" deep. A smaller box could have been used, but I'm glad I used this one since I ended up putting several other circuits in it, which I'll describe later.

In Fig. 3, we see the schematic for the deluxe version. It is deluxe because it has the ability to tune the transmitter and receiver incrementally and independently, and the ability to return to basic non-RIT/TIT operation. All parts in this and other circuits in this article are available at Radio Shack, and most of the parts may be substituted for by others if the ones called for aren't immediately available.

For example, the 2N3904 and 2N2222 and other transistors of similar characteristics may be substituted for each other. The 1N914, 1N4148, and 1N4001 diodes may be interchanged since they all will work effectively in the circuits. The same is true for almost all parts used. The 12-volt zener diode is the one part I haven't specified by number since almost any 12-volt zener (½ Watt) will work fine.

The trimpots may be linear or log taper, but the RIT/TIT control pots seem to work best if they are linear. The circuit is not linear across its range, but it is still pretty good except near one end of the pot's rotation. Even then, it's reasonably smooth.

The construction method I used was to mount all parts on a small piece of 100-thousandths-grid perforated board (from Radio Shack, since that's all we have here); then, pigtails from the various controls and switches were attached to the board-mounted components. There was enough strength from the leads so that no mounting problems

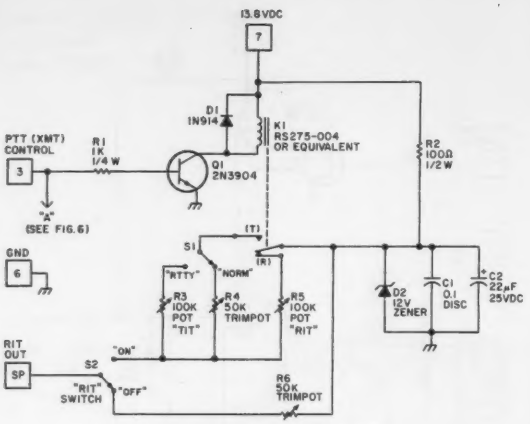

Fig. 4. RTTY circuit.

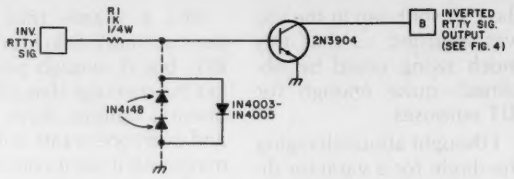

Fig. 5. RTTY flipper.

were encountered. A bit of GE's RTV (or bathroom tile silicone rubber) may be used to secure the board and relay.

The same general procedures may be used for adjusting the various pots (R3 through R6) as was described for the simple RIT circuit. First, adjust R5 (Fig. 3) for center frequency. Then turn RIT switch S2 to OFF and adjust R6 for the same frequency on readout. Turn S2 to ON and then adjust R4 with mike gain turned fully counterclockwise, mike PTT switch on, and S1 in NORMAL. Then check operation of R3 with S1 in the RTTY position. The transmit frequency should vary as indicated by the digital readout. This concludes the calibration and checkout of the circuit.

Resistor R1 in Fig. 3 is in the circuit to limit current in the transistor's base circuit. It also serves to isolate transistor Q1 from the PTT control signal line. Diode D1 keeps the inductive kickback voltage or "flyback" voltage (developed across relay K1's coil by the collapsing field when Q1 turns off) from becoming excessive and possibly "puncturing" Q1's junction, thereby ruining Q1.

Resistor R2 limits current through zener diode D2 to a safe level and allows a voltage difference between D2's 12-volt clamping effect and the 13.8-volt source. Capacitor C1 keeps the zener from generating white noise due to random current paths through the zener's junction. Capacitor C2 is cheap insurance to further guarantee that no possible drive can occur due to any residual instability during transmit.

Numbers inside terminals on the diagram refer to pin numbers of 104's accessory socket. The letters SP indicate a SPARE socket on the back of the 104. Since the deluxe version is basically an external add-on, connections must be made. Therefore, all connections are made to already existing signal and power-supply connections at the accessory socket, and the orange wire (LSB shift on vfo) is then brought out to a spare socket by routing an extension pigtail wire along the cable which runs down the center of the printed circuit board sockets underneath the 104 chassis. Use plastic ties or lacing twine of some kind to secure the wire.

Itty Bitty RTTY

While the information given up to this point is applicable to the vast majority of 104 users, there are enough RTTY freaks around (including myself) who make use of or are interested in possibly using direct RTTY modulation. I've found AFSK (audio frequency shift keying) using the generator kit offered by one of the well-known companies to be the easiest for me to put into service while avoiding any modification to the rig. But since the RIT addition was so available for experimentation, addition of some half-dozen parts to the workhorse circuit of Fig. 3 also gives direct FSK and only costs about $3.00 more.

The circuit of Fig. 4 shows how an optoisolator (Radio Shack #276-1628), a trimpot, and a fixed resistor do this. The tuning procedure is similar to the previous versions except that the shift and frequency pots may interact so that you may have to alternately adjust each pot (R5 and R6) until the desired results are obtained. The digital readout on the 104 makes this fairly easy, but a local "RTTY buddy" should be on hand to let you know how things are going on his set. Of course, it goes without saying that RTTY would be set up and used on lower sideband to be compatible with the normal use of RTTY on HF bands when one is using AFSK. But this system is normally set up and used on the air in the CW mode. Remember: Limit power during tests and operation to about 25 Watts output to save your transistors. More about this later.

The circuit shown in Fig. 4 uses a RTTY signal which normally goes to ground on "make." This is the scheme used with my Microlog keyboard, but in case your system should need the opposite (or an up-going) signal, Fig. 5 shows how another transistor and resistor may be used to get this type of operation going for you. The diodes connected from the base of the transistor to ground, in Fig. 5, may be used if your system has high-voltage switching, in which case the base-current limiting resistor also will need to be changed in value by using Ohm's law and the power law.

With the Microlog system, I was able to use a 2N2222 instead of the optoisolator, but a local friend, Lee KJ5P, told me that he had to use an optoisolator with his Model 15 to keep from getting hum on his transmitted signal. I haven't seen his circuit, but there probably isn't much difference between his circuit and this one. By the way, Lee used his 104 external vfo for the modification, and in doing this was able to avoid opening the 104 itself. The vfo is the same as the internal vfo, circuitwise, so operation still is the same. In my case, I still use AFSK but have the ability of going FSK in a few moments just by switching cables.

Word of mouth has it that the 104 can transmit at 50 Watts output by using a cooling fan on the heat sink's cooling fins (running RTTY). With four transistors good for about 70 Watts dissipation each, this may be very possible, mainly dependent upon the efficiency of the heat-exchange system. However, I've set a limit of 25 Watts output—and this is only when using a cooling fan. With the 104 on low power into a Den-Tron GLA-1000 amplifier, I

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get about 65 Watts into the dummy load and this can be done all day without damage to the final transistors or driver transistors. Although protection is built in for the finals, I'd rather play it safe, and 65 Watts is enough for most purposes when you have a good antenna. In high power and very little drive, the GLA-1000 will run 150 Watts output, about the maximum safe level for the amplifier.

A spin-off of the RIT project is that I'm able to use the PTT signal in the RTTY box to key up the amplifier on low power. Heath fixed it so that the 104 may key an amplifier, but the relay keying is done only when in high power. Fig. 6 shows a relay-driver circuit with diodes to protect the transistor from any possible damage from kickback spikes from the relay. With this circuit, I can key the amplifier while on low power.

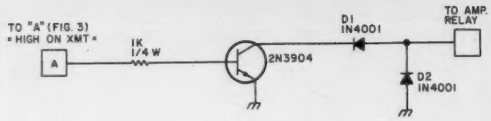


Fig. 6. Amp op.

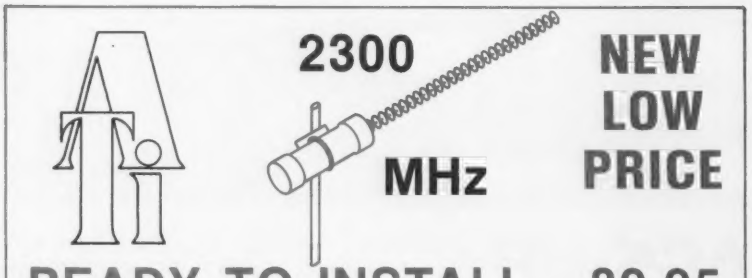
A call to Benton Harbor gave me some additional information about RIT on the 104. While talking to one of the "supertechs," I found that an engineer there had put RIT in his 104 in some way by using the LSB shift control line to the vfo. (The technician objected, saying that the frequency shifted when changing from USB to LSB; he opined that this was somehow detrimental when changing sidebands. The fact that his boss did it and it worked was for him apparently secondary to design concepts. Perhaps this is a desirable quality in a technician!)

I was also informed that a *QST* article had a circuit for RIT on the 104 requiring one to go into the vfo. I went back into my vfo when converting my 104 to the A model, and it didn't change my opinion that it's better to leave a potential drifter alone! Unless one gets thrills from complexity, simplicity is better, permitting the operator to get it together and going without delays.

Merely taking note of the readout frequency on the 104 and tuning to it when changing sidebands puts you right back on frequency since the 104 computes everything for you. But with the recognized standard of certain sidebands being used for the different bands, when would one need to change sidebands on a particular band (except to prove that it can be done)? In normal usage, this is never done by the operator.

So now you have it. You've seen how it was done and how it can be done and perhaps this has given you some ideas for improving your system. And looking at a schematic of a 104 will show you that only three or four parts are needed in the vfo circuit to shift the frequency. If your rig doesn't have RIT, these few parts, with a little bit of thought and just a little experimentation, could give you RIT and the added versatility—even if your rig isn't a digital marvel like the 104.

Special thanks to Lee KJ5P for his initial experimentation and for proving that it could be done even before I decided to roll my own. I guess you can say we'd both rather be shifters than drifters! ■



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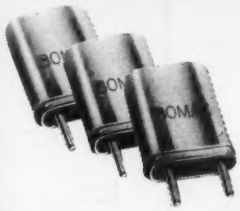

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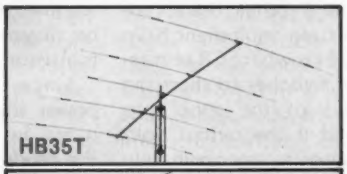

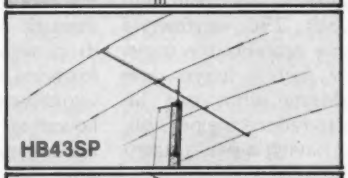

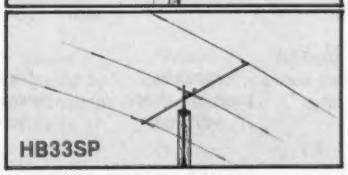

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Protect Your Pass Transistors

—the crowbar connection

After purchasing a Ten-Tec 544 transceiver and matching 262M power supply, I became concerned about the possibility of the pass transistor in the supply shorting and causing damage to the transceiver. If the transistor fails by shorting, approximately 23 volts will be applied to the transceiver.

Others concerned about shorted pass transistors in this and other brands of solid-state equipment have added crowbar SCR or transistor switches to short the output of the supply to ground if the output voltage rises to approximately 15 volts. This worthwhile scheme protects the transceiver, but it leaves one wondering what can be done to reduce the possibility of having a pass transistor fail.

It seems obvious that if the pass transistor can be made to run cooler, it is less likely to fail. Therefore, a simple method of cooling the pass transistor was sought. The instruction manual for this and other transceivers suggests fan cooling for high duty-cycle operations such as RTTY. Fans can be noisy and hard to mount. A more direct method is to reduce the amount of power that must be dissipated by the pass transistor.

Since the amount of power that must be dissipated by the transistor is the product of the current through and the voltage drop across the transistor, lowering either one of these variables would do the job. Lowering the output voltage or current is not acceptable to most operators since it results in reduced output power. The only acceptable change appears to be to reduce the input voltage to the pass transistor while still maintaining normal output current and voltage.

Measurements made on my 544 at full output power on CW on 40 meters showed that with my 120-volt ac line, the input to the pass transistor was 19 volts at a load current of 13 Amperes. Under these conditions, the transistor is dissipating 68 Watts of power. I then connected the ac input of the 262M power supply to a variable ac source, and tests were run to determine how low the nominal 115-volt input could be made while still maintaining excellent voltage regulation at the required current of 13 Amperes.

I found that for my supply, the input could be lowered to 102 volts with only a 0.09-volt reduction in the output voltage! Under these conditions, the pass transistor was only dissipating 28 Watts, a reduction of 40 Watts or 59% over the operation at the full 120-volt condition! Of course, the transistor runs much cooler under these conditions and is less likely to fail. The results of these tests are shown in Table 1.

To take full advantage of this information, one could connect the input of the supply to a continuously adjustable ac voltage source rated at 3 Amperes (for the 544/262M) and reduce the ac voltage until the nominal 13.8-volt output just starts to drop from its no-load value when the transmitter is keyed at full output power.

The "output" pilot lamp on the 262M supply will flicker when this point is reached. Unfortunately, continuously variable ac voltage sources such as Variac or Powerstat autotransformers are expensive and not always readily available, so a different method is used.

As shown in the schematic diagram in Fig. 2, a low-voltage filament transform-

Input, volts ac	Input to pass transistor, volts dc	Output of power supply, volts dc	Power dissipated by pass transistor (Watts)	Power saved over 120-V input condition
120	19	13.76	68	Original
112	17.9	13.76	54	14 W = 20%
108	16.9	13.76	40	28 W = 41%
102	15.8	13.67	28	40 W = 59%
95	14.03	12.72	17	51 W = 75%

Table 1. Pass-transistor dissipation and output voltage vs. ac input voltage for the Ten-Tec 262M power supply. Notes: 1. Load current was 13 Amperes as indicated on Ten-Tec ammeter. 2. All voltages measured with a Fluke 8022 DVM. 3. 95-volt input arbitrarily deemed not an acceptable operating condition. 4. Ac input current to power supply at 120 V ac was 2.5 Amperes. 5. Ac voltages measured at pins on power-supply line cord plug.

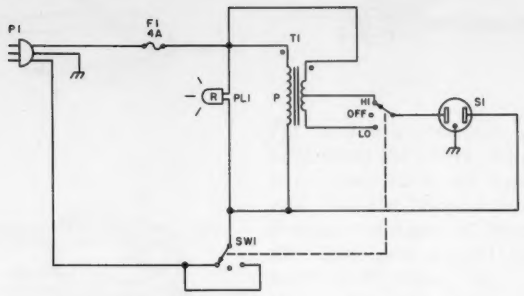

Fig. 1. Schematic of the pass transistor saver. SW1—DPDT toggle switch with center off position; S1—120-volt chassis-mount receptable; T1—Filament transformer, 117/12.6 V c-t at 3 A (Stancor P-8358 or equivalent, see text).

er is connected in a manner that allows approximately 6.3 or 12.6 volts to be subtracted from the normal supply voltage. At low loads, such as 13 Amperes, the switch is placed in the Low position to subtract 12.6 volts from the ac supply line. At greater load currents, such as 16 Amperes, the switch is placed in the High position to subtract 6.3 volts from the ac supply line.

Table 2 shows the results of tests made when operating the 544 using the filament transformer. When operating at full output power on 40-meter CW, my pass transistor is now dissipating only 26 Watts, a savings of 42 Watts or 62% over full 120-volt line voltage operation. My pass transistor heat sink is now cooler than the heat sink on the transmitter's final output transistors after a full evening's operation.

Since more than 13 Amperes may be required for full output power on other bands, a test was conducted at a load current of 16 Amperes using a filament transformer. The results of this test also appear in Table 2, and show that at least a 40% savings in power dissipation can be realized while still maintaining excellent voltage regulation.

Construction and parts layout is not critical. The unit was constructed on a 2" × 4" × 5" chassis. Proper phasing of the transformer windings is accomplished by the cut-and-try method. If your trial connection causes an increase in output voltage, reverse the secondary leads of the transformer. For safety, make these tests with the transceiver disconnected from the unit. Purists may want to install an additional 1/2-Amp fuse directly in series with the primary of the transformer.

If the normal line voltage at your location is significantly less than 120 volts, such as 110 volts, a 10-volt c-t transformer or even a 6.3-volt c-t transformer may be more suitable than the 12.6-volt unit specified. When selecting a transformer, keep in mind that the output voltage of a filament transformer varies as its load current varies. The output voltage of a transformer rated at, say, 12.6 V at 5 Amps will be more than 12.6 V at currents less than 5 Amps assuming rated primary voltage. Two or more transformers with the secondaries connected in series could be used with a multiple-position selector switch to give a greater number of combinations.

Equipment manufacturers must design their supplies to operate over a wide range of input voltages. If the voltage at your location is on the high end of the scale, or even in the middle, this unit will allow your power supply pass transistor to run cooler while still maintaining good voltage regulation and maximum transmitter output power. This, combined with a crowbar, will reduce the chances of damage to your transceiver and may save you the trouble of locating and replacing a defective pass transistor. ■

Switch position	Load current (Amps)	Input to pass transistor, volts dc	Output of power supply, volts dc	Power dissipated by pass transistor (Watts)	Power saved over 120-V input condition	Ac input to power supply, volts
Note 3	13	19.1	13.88	68	Original	120
Low	13	15.8	13.82	26	42 W = 62%	103.7
High	13	17.4	13.88	46	22 W = 32%	112.0
Note 3	16	18.0	13.88	66	Original	120
Low	16	14.7	13.20	24	42 W = 63%	Note 4
High	16	16.3	13.82	40	26 W = 40%	Note 4

Table 2. Results when operating the power supply from the transformer voltage-reducing unit. Notes: 1. A slight flicker could be seen on the 262M power-supply Output light in the Low, 16-Amp condition. 2. These tests were run one week after the tests shown in Table 1. Note that normal output voltage is slightly (0.12 V) higher. 3. None-across-the-line operation for reference. 4. Not measured. 5. Normal line voltage was approximately 120 volts.

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All Tied Up in Knots?

—the twisted tale of Thomas J. O'Harra

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My grandfather was Nazario Garcia Baca, and he was the very first radio amateur in all New Mexico. He was also a sheep rancher, and that brings up the most famous knot of all, the "sheepshank." But the sheepshank has nothing whatever to do with sheep, and Grandfather Baca never used one and you will never need one either, so skip it.

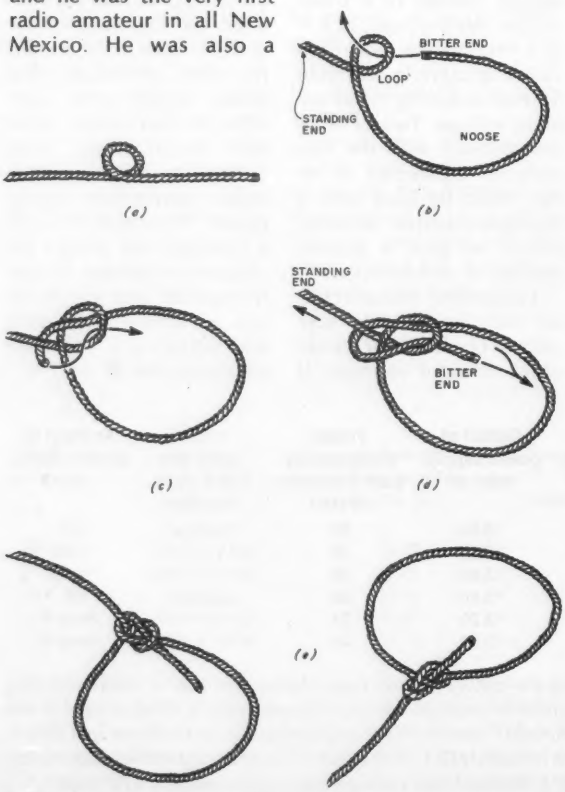

Fig. 1. The bowline. (a) Leave plenty of rope for both the noose and the knot, then form a loop. (b) Pass the bitter end through the loop as if you were tying a simple overhand knot. (c) Now take the bitter end around the standing end and back through the loop. (d) This is a bowline knot. All it needs is tightening in a special way. Notice that the bitter end has merely been folded back on itself. To tighten the bowline, pull the standing end while holding both the bitter end and the other rope that comes out of the same hole. Beware: If you pull it wrong, the knot will "turn inside out" and leave you with a useless slip knot around the bitter end. (e) The front and back of the tightened, finished bowline knot.

The Bowline

My other grandfather, Frank Elmer Jacobs, told me a story about another kind of knot, done on a ham—a ham actor, that is. It seems the good old boys in San Angelo (Texas) wanted to form a vigilante committee like the ones in San Francisco to get rid of a certain Thomas J. O'Harra, alias "Pretty Good Actor." (He had been legally acquitted three times in a row of swindling women by promising to marry them.) The committee had posters printed up, inviting Pretty Good Actor to a pretty good "necktie party."

Well, Pretty Good Actor was hard to bluff, and he was doing a couple of lucrative productions at the time, so he stayed. There was nothing to do but go ahead and hang the man for the glory of Texas and the honor of Texas women. The committee caught him coming out of play practice the very next night. They wanted to hang the man, but not kill him. Instead of the traditional "hangman's knot," they used a "bowline knot." It makes a noose that will not tighten up. By including Pretty's chin in an oversized noose and running the hanging rope up

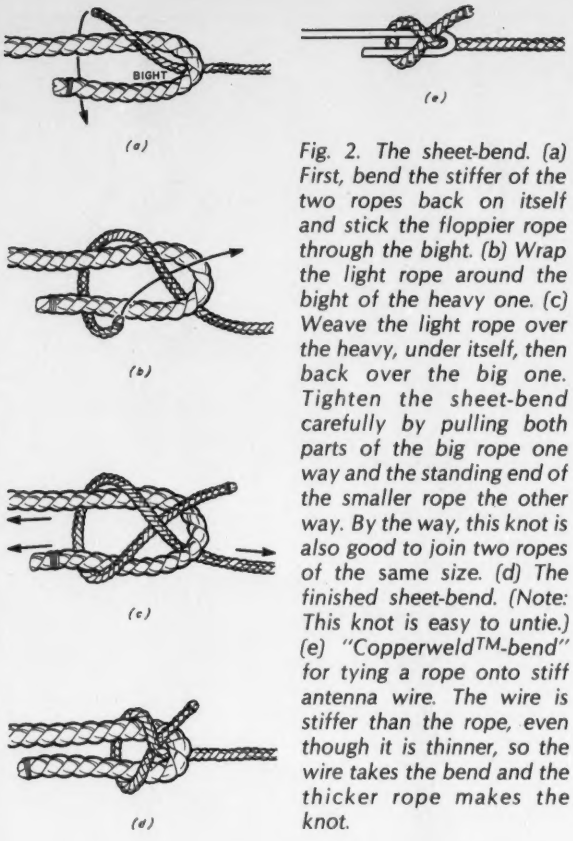

Fig. 2. The sheet-bend. (a) First, bend the stiffer of the two ropes back on itself and stick the floppier rope through the bight. (b) Wrap the light rope around the bight of the heavy one. (c) Weave the light rope over the heavy, under itself, then back over the big one. Tighten the sheet-bend carefully by pulling both parts of the big rope one way and the standing end of the smaller rope the other way. By the way, this knot is also good to join two ropes of the same size. (d) The finished sheet-bend. (Note: This knot is easy to untie.) (e) "Copperweld™-bend" for tying a rope onto stiff antenna wire. The wire is stiffer than the rope, even though it is thinner, so the wire takes the bend and the thicker rope makes the knot.

beside his nose instead of behind the ear, it did not cut off his air nor the circulation to his head.

The victim swung back and forth and slowly twisted in the night breezes, looking up the rope. The vigilante committee marched away then hid behind a fence and watched, barely able to keep from bursting out laughing. When Pretty Good Actor was convinced they were gone, he fished a knife out of his boot and cut himself down and was never seen again in San Angelo.

Today when I hung up my dipole on the flagpole, I used a bowline for the same reason. I wanted a loop that would not tighten. Also, a bowline is easier to untie than a lot of other knots. See Fig. 1.

The Sheet-Bend

The very useful "sheet-bend" got its present name in the British Navy over three hundred years ago. "Tie onto that big cable," the captain ordered. "Tie it?!" protested the gunner's assistant. "Sir, I can barely bend it." The old name of the sheet-bend was ŞÞvÞŦŦ.

The sheet-bend is really the same knot as the bowline. If you tie two ropes together with a bowline, it is called a sheet-bend. It is particularly useful for tying a little rope to a big one. I used a sheet-bend on each end of my dipole today to attach the nylon ropes to hold it up. You and I might privately call that a "copperweld™-bend," but the sailors and scouts wouldn't recognize it by that name. See Fig. 2.

The Double-Half-Hitch

Why didn't they call this one a "whole-hitch," or just a "hitch"? Anyway, I used it this afternoon to tie the northwest end of my sky-wire to a tower leg. It is good for that sort of thing, because you can tie it while you are pulling on the rope. See Fig. 3.

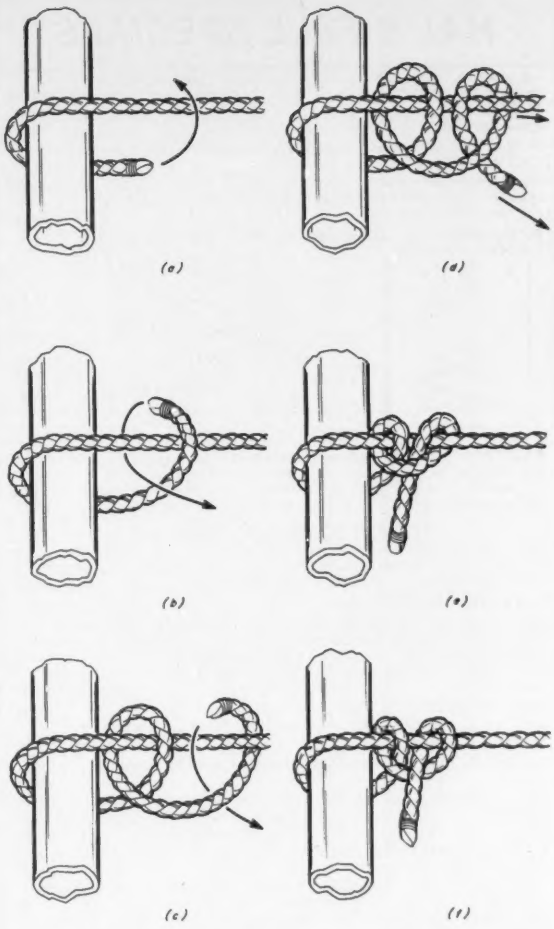

Fig. 3. The double-half-hitch. (a) Wrap the bitter end around the tower leg. (b) Wrap the bitter end around the standing end and poke it through the loop to form the first half-hitch. (c) Now do it again in the other direction to form the other half-hitch. (Note: If you make both half-hitches in the same direction, you get a clove-hitch instead. Either one works just fine.) (d) Just right. Now tighten it by pulling on the bitter end. If the standing cord is not under tension, pull on it, too. (e) The finished double-half-hitch. This can be tied in a rope with a wild horse (or a 160-meter dipole) pulling on the other end. (f) The clove-hitch. It is every bit as good.

The Packer's Hitch

Say you want to pack that triband beam and haul it up the mountain on Field Day. You get it all up on the rack of your cousin-in-law's plumbing truck. Then what? How do you tie it? Just wrap all the rope you own around it? Keep watching in the rear-view mirror for one of those slippery elements to fall out on the road behind you? Fig. 4 shows a little rope-trick that will really hold things together.

Summary

Just any old knot might fail you in a pinch. The bowline will make a noose that will not tighten up. Its cousin, the sheet-band, is good for tying ropes together, even if they are different

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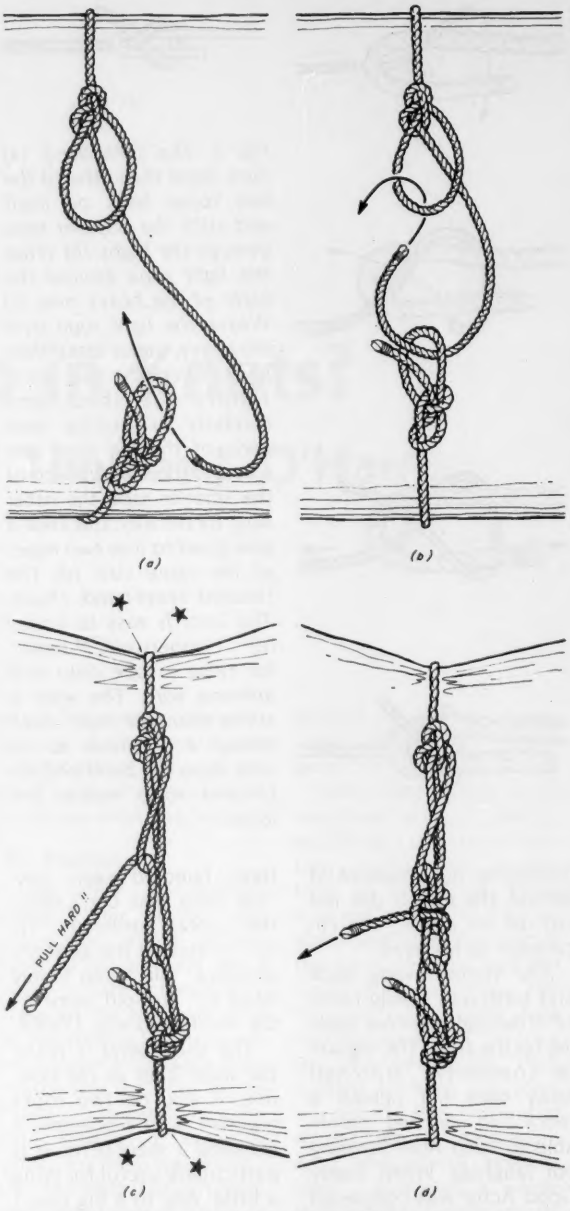

Fig. 4. The packer's hitch. (a) Wrap the rope around your load. Make a bowline at one end of the rope. Make another bowline near the other. Leave plenty of loose rope at the bitter end. (b) Loop the bitter end through both bowlines and pull down hard. (c) Now pull down harder! More! You have a three-to-one mechanical advantage now. Sock it to it! Str-r-e-e-t-ch that rope! (d) Now tie the bitter end around below the bowline with a double-half-hitch.

sizes. The double-half-hitch can be tied on a rope under tension. And the packer's hitch (which is a combination of the bowline and double-half-hitch) will let you put the squeeze on anything you can get a rope around. These special knots are good for passing the Boy Scout Tenderfoot exam and are good for many, many jobs in the Amateur Radio Service.■

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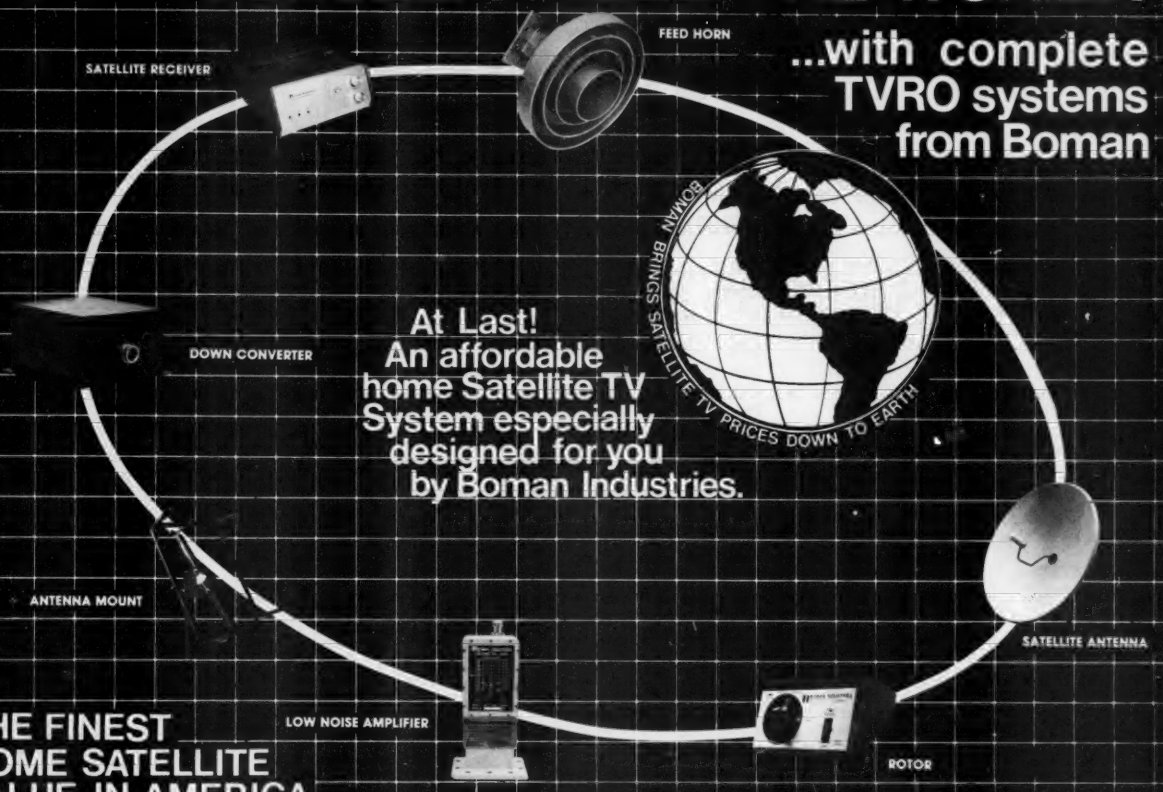

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	ANTENNA WIND-LOAD CAPACITY	
ROTATOR MODEL	MOUNTED INSIDE TOWER	WITH STANDARD LOWER MAST ADAPTER
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CD45 II	8.5 sq. ft. (.79 sq. m)	5.0 sq. ft. (4.6 sq. m)
HAM IV	15.0 sq. ft. (1.4 sq. m)	N/A
T²X	20.0 sq. ft. (1.9 sq. m)	N/A
HDR300	25.0 sq. ft. (2.3 sq. m)	N/A

For HF antennas with booms over 26' (8 m) use HDR300 or our industrial R3501.

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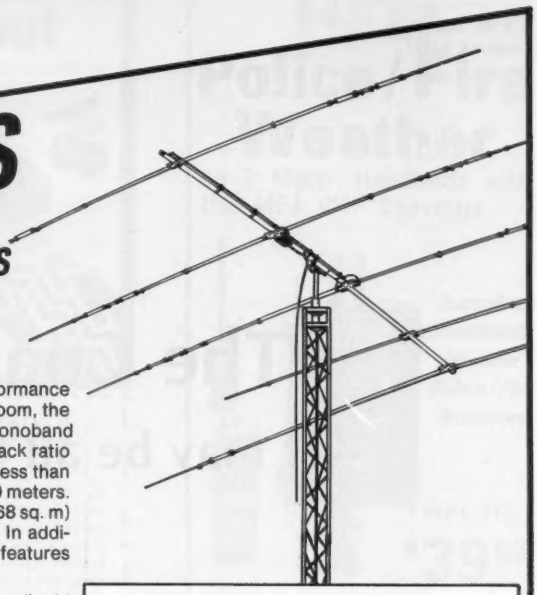

TH5Mk2 Now you can enjoy outstanding broadband antenna performance in a size to fit most city lots. With 5 elements on a 19 ft. (5.8 m) boom, the TH5Mk2 has 4 active elements on each band. Hy-Q traps and monoband parasitic elements achieve an 8.5 dB gain and an *average* front-to-back ratio of 19 dB on 20 and 10 meters, and 22 dB on 15 meters. VSWR is less than 2:1 over the 20 and 15 meter bands, and from 28.0 to 29.4 MHz on 10 meters. The TH5Mk2 weighs only 57 lbs. (25.8 kg). And with just 7.5 sq. ft. (.68 sq. m) surface area, wind-loading is 190 lbs. at 80 mph (86 kg-129 km/h). In addition, the TH5Mk2 offers the same solid construction and outstanding features as the TH7DX. See common features below.

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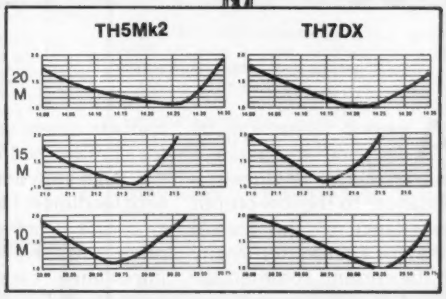

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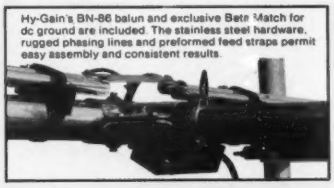

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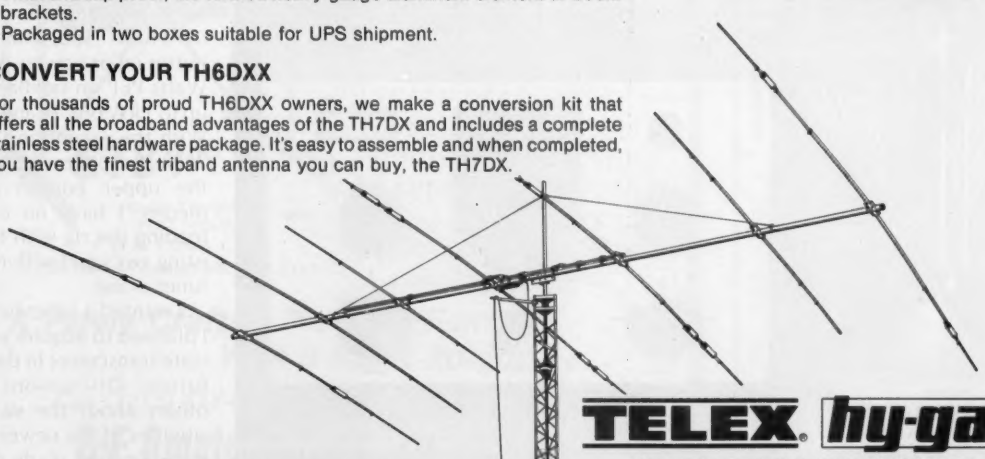

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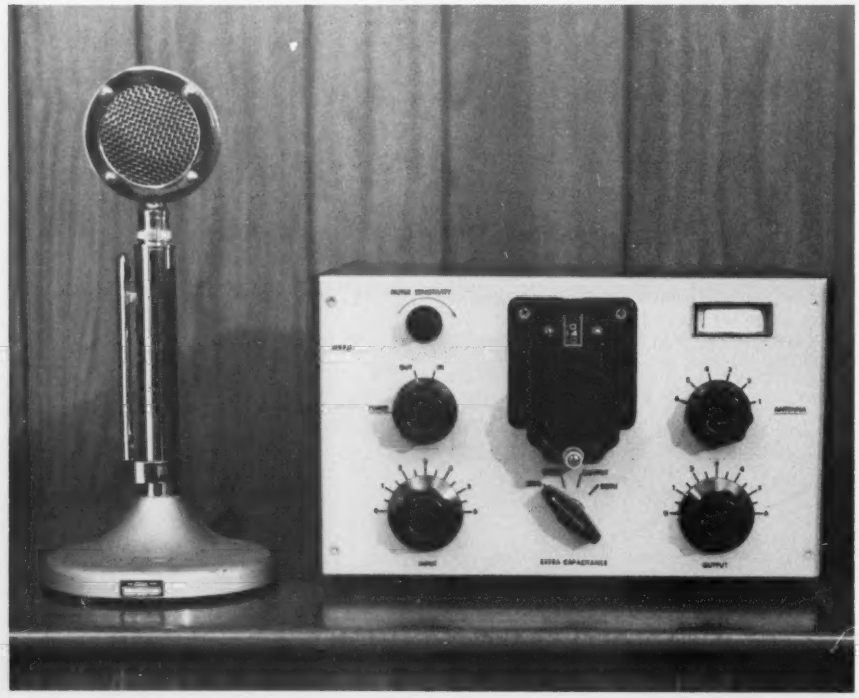
Antenna tuners can be designed to match a wide range of feedline impedances to the low-output impedance of the typical amateur transmitter. Many of the current, commercially-made tuners can be used for coaxial feedlines or for the high-impedance open-wire feedlines. This flexibility of use is not without its price, however, as the high-impedance capability requires the use of wide-spaced, high-voltage capacitors. These capacitors are characterized by their scarcity, large size, and high cost.

If the tuner could be limited to use with low-impedance coaxial feedlines from normal antennas, then a network could be built using tuning capacitors of the closer-spaced variety similar to the loading capacitors in today's linear amplifiers. Fig. 1 is a schematic of such a "coaxial tuner" that I built and use with my HF antennas, which include a tribander for 20, 15, and 10, a quarter-wave vertical for 40, and an inverted vee for 80 meters. My ham gear is the old vacuum-tube type with transmitter input powers of 1200 Watts PEP on sideband and up to 1 kW on CW and RTTY. With the exceptions of the 75-meter phone band and the upper portion of 10 meters, I have no trouble loading the rig with the existing swr's and with no line tuner in use.

I wanted a tuner because I planned to acquire a solid-state transceiver in the near future. Discussions with others about the swr sensitivities of the newer solid-state rigs had made me revise my former negative attitude towards coax tuners or line matchers. A tuner is



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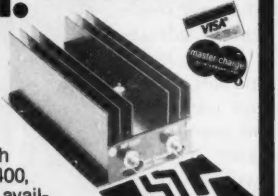

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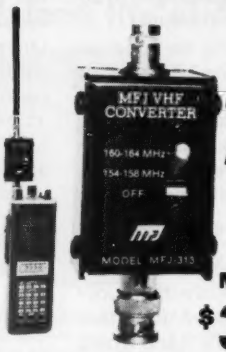

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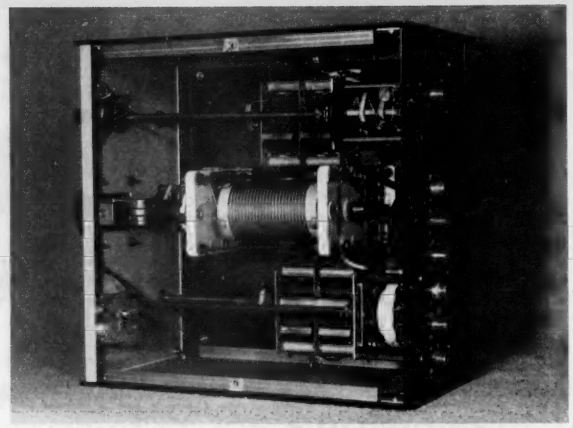
certainly a much simpler way of making a solid-state rig happy than trying to find an antenna that presents a constant 52-Ohm load from one end of the band to the other. The coax losses are not decreased, or increased, but the desk may have to be rearranged to accommodate the tuner.

When using the tuner on 75 meters, the 1200-pF variable capacitors did not have enough total capacity, so switch S2 and capacitors C3 and C4 were used to provide an additional 500 pF on the input, on the output, or on both when needed. The in/out switch, S1, is used to remove the tuner from the circuit for those portions of the band where the swr is a reasonable figure. The antenna switch, S3, merely selects the coaxial line of your choice. I use one of the output connectors to feed my dummy load and find this convenient for tune-ups or tests. The rf level meter is to ensure that the tuner is set for maximum output rather than to a false resonance.

The leads connecting the inductor and the variable capacitors should be as short in length and as large in cross-section as you can manage. With my prototype breadboard unit, I could not obtain an swr of 1 to 1 on frequencies above 29.2 MHz and found that, while the inductor had reached its minimum value, I still needed less inductance. Changing from number 14 wire to 3/8" copper strap decreased the lead inductance and cured the problem. Purists may question the open-type switch used to select the various antenna connectors, but the swr meter shows no serious effects. If any undesirable swr effects did occur, they could be corrected by the tuner.

An swr meter should be connected between the transmitter and the tuner so that the tuner can be adjusted properly. This is also the correct place for the power meter since swr's greater than 1 to 1 can give some very odd power readings. Initial tuning adjustments should be made at the lowest power level needed for your particular swr meter. The amount of inductance and capacitance needed will vary from band to band and will depend upon the swr of each antenna, the length of the feedline, and whether you are operating above or below the resonant frequency of the antenna. Initial adjustments may get to be a bit tiresome, so the settings should be logged for future use.

I recommend that a systematic approach be used in tuning the network as the adjustments are somewhat interactive and a helter-skelter knob-twister could get a bit frustrated. For initial adjustments on any frequency of interest, I first set the inductance so that one turn was in use. Then I varied both the input and output capacitors to find their effect upon the swr. If the swr was still high, I put another turn of the inductor in the circuit and again



Inside view of tuner.

readjusted the capacitors, looking for a decrease in swr. This process was continued until the desired 1 to 1 swr was obtained.

Fig. 2 is a chart showing the approximate settings I obtained at various frequencies. The feedlines to the beam and to the inverted vee are about 150 feet long. The line to the vertical is about 50 feet long. Swr measurements were taken with a Heathkit HM-102 swr/wattmeter.

The in/out switch and the antenna switch are mounted on aluminum plates which are parallel to and spaced about 2½" from the rear panel. This permitted the wiring of these switches and the antenna connectors prior to final assembly. It did require the use of rather long ¼" shafts to reach the front panel. The small RG-8/M mini-foam coaxial cable from Radio Shack makes the wiring easier than it would be with normal size RG-8/U.

For the wiring between the antenna switch and the coaxial connectors, I used direct, unshielded wire where the switch and connectors were so close that coax would have been awkward or nearly impossible to use. The coaxial con-

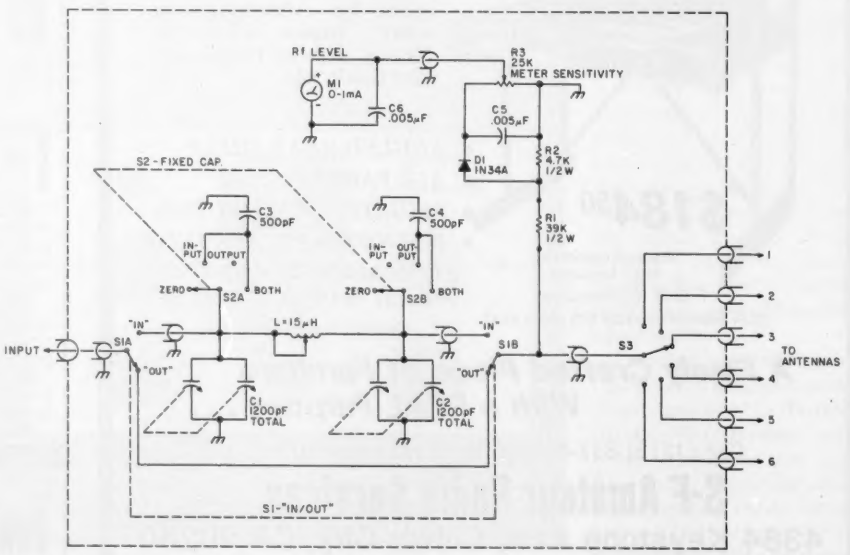


Fig. 1. Coax tuner/antenna switch.

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C1, C2	2-gang broadcast receiver-type capacitors, 600 pF per gang
C3, C4	500-pF ceramic or mica transmitting capacitors (high voltage)
C5, C6	.005-uF, 200-V disc
R1	39k, ½ W
R2	4.7k, ½ W
R3	25k pot
L	15-uH variable inductor
D1	1N34A germanium diode
M1	0-1 milliammeter
S1	DPDT ceramic wafer switch, two section
S2	DP4-position ceramic wafer switch, two section
S3	SP multiple position, to match number of connections required

Cabinet pictured—Moduline 7-12-12

nectors are mounted in a straight line across the rear panel. A much better arrangement would be to mount them in a circle so that very short direct leads could be used between the antenna switch and the respective connectors.

The rf voltmeter voltage-divider/rectifier components are mounted on a terminal strip near the in/out switch since this was a convenient location to sample the rf voltage. The B & W #3852 inductor has a total of 24 turns of wire and its inductance of 15 uH is more than is needed. Ones with maximum inductances of 7-10 uH would probably do as well and would probably be much smaller physically.

Parts procurement is always a problem for the builder, even for simple projects like this tuner. Surplus dealers are likely to have suitable variable capacitors, switches or switch sections, and perhaps variable inductors. Exact duplicates are not necessary. Capacitors with 4 gangs each and totalling about 1800 pF would be great as they would allow the elimination of C3 and C4 along with switch S2. A tapped coil could be used instead of the rotary coil. If so, I recommend a tap each half turn at the low-inductance end of the coil for about 4 taps or so, as the 10-meter inductance values may be quite small and a change of a whole turn at a time may miss the best spot. Better yet would be to make the last tap experimentally after assembly and near any problem frequency encountered. Cabinets are now rather expensive items, so home-brew or surplus ones may be a good choice. Many turns-counting dials are available commercially. The one pictured is an old surplus B & W #11282 of ancient vintage.

I used light grey spray paint on the front panel and identified the controls with press-on lettering. A few light coats of clear plastic spray paint were then applied to protect the finish. Switches S1 and S2 were assembled from ceramic wafers from my junk box and I used two wafers each to provide some isolation between sections. Switch S3 is a husky switch from a surplus BC-375 antenna-tuning unit. The knobs were also resurrected from my junk-box assortment.

A final word of caution: This coaxial tuner is not designed for wide variations in load impedance. If you have a shorted trap in your tribander beam and an swr of 10 to 1, this tuner will not correct your problem. It is not suitable for use with open-wire line. High-load impedances *cannot* be matched without developing high voltages across the capacitors with consequent arcing and damage. The tuner is capable of tuning out the reactance of coaxial cables feeding normal, resonant antennas and can present an apparent swr of 1 to 1 to the rig. ■

Ant Resonance MHz (swr)	Test Freq MHz	Swr without tuner	Tuner Values for 1:1 Swr Input C pF	Inductance (# turns used)	Output C pF
3.66	3.505	3+ +:1	600	5T	940 + 500 FIXED
(1.3:1)	3.950	3+ +:1	800 + 500 FIXED	3.8T	1080
7.20	7.005	1.4:1	800	4.3T	740
(1.1:1)	7.295	1.2:1	740	4.3T	720
14.10	14.005	1.8:1	680	2T	620
(1.15:1)	14.345	2:1	720	2T	620
21.10	21.005	1.15:1	100	1.9T	200
(1:1)	21.440	1.8:1	100	2.3T	200
28.5	28.005	1.3:1	0	1.3T	160
(1.1:1)	29.100	2.9:1	200	1.4T	0
	29.600	3+ +:1	260	1.7T	320

Fig. 2. Representative tuner settings.

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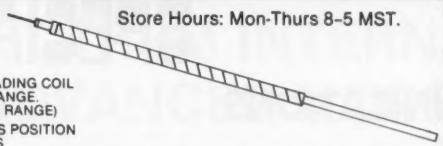

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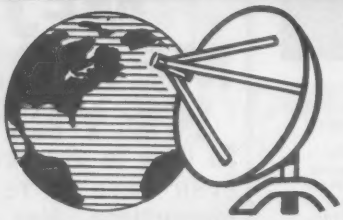

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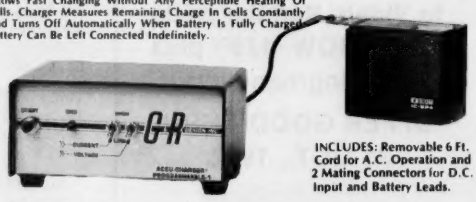

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CORNWALL NY
OCT 2

The Orange County ARC will hold its annual auction on Saturday, October 2, 1982, from 10:30 am to 2:30 pm, at Munger Cottage, Cornwall NY. Sellers will be admitted at 9:00 am. Admission is $1.00. Talk-in on 146.52. For further information, call Bill N2CF at (914)-928-6288.

SYRACUSE NY
OCT 2

The Radio Amateurs of Greater Syracuse (RAGS) will hold their annual hamfest on Saturday, October 2, 1982, from 9:00 am to 6:00 pm at the Art and Home Center, New York State Fairgrounds, Syracuse NY. There will be commercial exhibitors and a large indoor flea market. Breakfast and lunch will be served. Door prizes, tech talks, a program on DXpeditions, women's activities, entertainment, and various contests will be featured. Admission is $3.00 and indoor flea-market space will also be available. Talk-in on .90/.30 and .31/.91.

ANNISTON AL
OCT 2-3

The Calhoun County Amateur Radio Association will hold its 3rd annual Anniston Hamfest on Saturday and Sunday, October 2-3, 1982, at the City Auditorium, Anniston AL. On Saturday, doors will be open from 9:00 am to 5:00 pm; on Sunday, from 9:00 am to 2:00 pm. Exhibitors may begin setting up at 7:00 am both days. Admission is free, as well as coffee, bingo, and parking for self-contained RVs. The FCC will administer exams. Talk-in on 147.69/.09 and 146.10/.70. For more information and reservations, contact Dale Boothe KA4LRL, 3430 Greenwood Avenue, Anniston AL 36201.

BOXBORO MA
OCT 2-3

The Federation of Eastern Massachusetts Amateur Radio Associations will hold the New England ARRL Convention on October 2-3, 1982, at the Sheraton Boxboro Hotel, Route 495 at Route 111, Boxboro MA. On Saturday the hours will be 9:00 am to 5:00 pm and on Sunday, 10:00 am to 5:00 pm. Early-bird registration is $4.00. The Saturday evening banquet, dance, and show is $13.50. Features will include a Wouff Hong midnight ceremony Saturday and YL programs on both days. For reservations and advance registration, send an SASE to Arthur Tomkinson W1THT, 9 Oliver Terrace, Revere MA 02151 and make checks payable to FEMARA.

WARRINGTON PA
OCT 2-3

The Pack Rats sixth annual Mid-Atlantic VHF Conference will be held on Saturday, October 2, at the Warrington Motor Lodge, Rte. 611, Warrington, PA. Advance registration $3.00; at the door, $4.00. Price includes admission to the 11th annual Pack Rats Hamarama on Sunday, October 3, at the Bucks County Drive-In Theater, Rte. 611, Warrington, PA. Admission to the flea market $2.00 and tailgating $4.00 per space. Bring your own table. Gates open at 7:30 am. Talk-in via W3CCX on 146.52. Information for both events is available from Hamarama '82, POB 311, Southampton PA 18966 or Lee A. Cohen K3MXM at (215)-635-4942.

ROCK HILL SC
OCT 3

The York County Amateur Radio Society will hold its 31st annual hamfest on Sunday, October 3, 1982, at Joslin Park, Rock Hill SC, starting at 0700. Pre-registration is $3.00; at the gate, $4.00. There will be prizes. Talk-in on 146.43/147.03 and 146.52. For additional information, contact YCARS, Box 4141 CRS, Rock Hill SC 29730.

YONKERS NY
OCT 3

The Yonkers Amateur Radio Club will hold its electronics fair and flea market on Sunday, October 3, 1982, from 9:00 am to 5:00 pm, rain or shine, at Yonkers Municipal Parking Garage, corner of Nepperhan Avenue and New Main Street. Admission is $2.00 each; children under 12 will be admitted free. Sellers' spaces are $6.00 (bring your own table) and include one admittance. Gates will be open to sellers at 8:00 am. There will be live demonstrations, hourly prizes, an auction, free parking, refreshments, and unlimited free coffee all day. Talk-in on 146.265/146.853, .52, or CB channel 4. For further information, write YARC, 53 Hayward Street, Yonkers NY 10704, or phone (914)-969-1053.

SAN ANGELO TX
OCT 3

The San Angelo Amateur Radio Club will hold its annual swapfest on Sunday, October 3, 1982, starting at 8:00 am, at the clubhouse adjacent to Mathis Field, San Angelo TX. Pre-registration tickets are $4.00 and tickets at the door are $5.00. There will be a bar-b-que served on the grounds and door prizes. Talk-in on .34/.94. For more information, contact Mark Haskell, Rte. 3, Box 92, San Angelo TX 76903.

ROME GA
OCT 3

The 1982 Rome Hamfest will be held on Sunday, October 3, 1982, from 9:00 am to 4:00 pm, at a new location, the Rome Civic Center, Turner McCall Boulevard (US 27 and GA 20), Rome GA. Features will include a barbecue and ladies' prizes. Talk-in on 147.90/.30. For more information, contact Buddy Waller NO4U, 18 London Lane, SE, Rome GA 30161.

GRAND LEDGE MI
OCT 3

The Central Michigan Amateur Radio Club will hold Ham-Fair '82 on October 3, 1982, starting at 8:00 am, at the Grand Ledge High School, Grand Ledge MI (7 miles west of Lansing). Registration for adults is $2.50. Tables are 75¢ per foot. There will be ham gear, accessories, computers, electronic equipment for the home, prizes, demonstrations, a swap shop, a cafeteria, and parking. Talk-in on .34/.94 and .52. For more information, write Ham-Fair '82, PO Box 10073, Lansing MI 48910, or call (517)-626-2237.

MT PROSPECT IL
OCT 3

The Mt. Prospect Amateur Radio Club and Cook County ALERT will hold RACOM '82 on October 3, 1982, at Prospect High School, 801 W. Kensington, Mt. Prospect IL. Advance tickets are $1.50 and tickets at the door are $2.00. Doors will open at 8:00 am. There will be a large indoor electronics flea-market area, commercial exhibits, seminars, door prizes, and more. Talk-in on 146.52. For more information or reservation forms for flea-market or commercial booths, send an SASE to RA-COM, PO Box 89, Mt. Prospect IL 60056.

SANTA CRUZ CA
OCT 8-10

The Santa Cruz County Amateur Radio Club will host the 1982 Pacific Division Convention on October 8-10, 1982, at the Holiday Inn, 611 Ocean Street, Santa Cruz CA. Full registration is $25.00 and includes the Sunday banquet, the ladies' program with lunch, all Friday evening events, and all forums and technical talks. Registration for forums and talks only is $7.00. Booths are $100. Friday evening events include exhibits, a league session, and a hospitality room. For more information, please write SCCARC Convention, PO Box 238, Santa Cruz CA 95061, or phone (408)-426-6691.

ASHEVILLE NC
OCT 9

The Western North Carolina Amateur Radio Society will hold its seventh annual Autumnfest on October 9, 1982, at the Asheville Civic Center, Asheville NC. Admission is $3.00 in advance and $4.00 at the door. Flea market tables will be $5.00 at the door. Activities (all indoors) will include the McElray Memorial CW Competition, bingo for the ladies, and dealer and flea market tables. Travel, motor home, and camping facilities will be available. Talk-in on .31/.91, .16/.76, and .52. For more information, contact WCARS, PO Box 1488, Asheville NC 28802.

PARK RAPIDS MN
OCT 9

The Headwaters Amateur Radio Club will hold a hamfest on October 9, 1982, from 9:00 am to 5:00 pm, in the Middle School Gym, Park Rapids MN. Admission is $2.00, display tables are $3.00 each, and commercial companies are $5.00 each. Refreshments and prizes will be available. Talk-in on 147.300 and 147.900.

MEMPHIS TN
OCT 9-10

The Memphis Hamfest will be held on October 9-10, 1982, in the Mid South Building at the Memphis Fairgrounds, Memphis TN. Children under 14 will be admitted free. The hours will be from 8:00 am to 4:00 pm on Saturday and 8:00 am to 2:00 pm on Sunday. The deadline for flea-market and dealer setups is 9:00 pm on Friday. Activities will include forums, ladies' programs, and a Saturday night hospitality party. There will be on-site trailer hookups available. Talk-in on .28/.88 and .25/.85.

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VIRGINIA BEACH VA
OCT 9-10

The ARRL Virginia State Convention and Tidewater Computer Show-Hamfest-Electronic Flea Market will be held on Saturday and Sunday, October 9-10, 1982, from 9:00 am to 5:00 pm both days, at the pavilion in Virginia Beach VA. Admission is $3.50 for both days. Flea-market tables are $5.00 for one day or $8.00 for both days; commercial flea-market tables are $15.00 for both days, and commercial booths are $30.00 for both days. Featured will be dealers, special displays, forums, computers, satellite equipment, special XYL programs, and a cocktail party Saturday night. There will be an advance ticket drawing for a hand-held transceiver, as well as many valuable door prizes. For more information and/or tickets, contact Jim Harrison N4NV, 1234 Little Bay Avenue, Norfolk VA 23503, or phone (804)-587-1695.

BEDFORD IN
OCT 10

The Hoosier Hills Ham Club will hold its 21st annual Hoosier Hills Hamfest on Sunday, October 10, 1982, at the Lawrence County 4-H Fairgrounds, 4 miles southwest on US Highway 50, Bedford IN. Registration is $3.00 per person and the swap shop is $2.00 (bring your own tables). The gate will open at 10:00 am on Saturday, October 9th, for campers and flea market setups (registration required). There will be a free fish fry, campfire, entertainment, coffee, and overnight camping on Saturday night. Features will include prizes, ladies' free bingo, and food served at the hamfest all day Sunday. Talk-in on 146.13/.73. For further information, contact Dick Reistter KA9JTZ, Secretary, Hoosier Hills Ham Club, Box 891, Bedford IN 47421.

PARAMUS NJ
OCT 10

The Bergen ARA will hold a ham swap 'n sell on October 10, 1982, from 8:00 am to 4:00 pm, at Bergen Community College, 400 Paramus Road, Paramus NJ. Buyers will be admitted free and sellers will be charged $3.00. There will be tailgating only; bring your own table. Thousands of spaces will be available. Talk-in on .79/.19 and .52. For more information, contact Jim Greer KK2U, 444 Berkshire Road, Ridgewood NJ 07450, or phone (201)-445-2855.

LIMA OH
OCT 10

The Northwest Ohio Amateur Radio Club will hold its sixth annual hamfest on Sunday, October 10, 1982, at the Allen County Fairgrounds, Lima OH. Indoor flea market tables will be available for $5.00 for an 8-foot table or $3.00 for half a table. Tickets are $2.50 in advance, $3.00 at the door. Doors will open at 6:00 am and grand prizes will be drawn at 3:00 pm. Overnight camping will be available at the fairgrounds. Talk-in on .07/.67, .83/.03, .34/.94, and .52/.52. For more information, write NOARC, Box 211, Lima OH 45802.

BALTIMORE MD
OCT 10

The Columbia Amateur Radio Association will hold its 6th annual hamfest on Sunday, October 10, 1982, from 8:00 am to 3:30 pm, at the Howard County Fairgrounds (15 miles west of Baltimore, just off I-70 on Rt. 144, 1 mile west of Rt. 32). Admission is $3.00, tables are $6.00, tailgating is $3.00, and indoor tailgating is $5.00. Food will be available and prizes will be awarded. Talk-in on 147.735/.135 and 146.52/.52. For table reservations or information, write Sue Crawford, 6880 Mink Hollow Road, Highland MD 20777, or phone (301)-286-3805.

WAUKESHA WI
OCT 10

The Kettle Moraine Radio Amateur Club will hold its annual Ham, Computer, Video Fest on Sunday, October 10, 1982, at the Waukesha County Expo Center, Highways F and FT, Waukesha WI. Tickets are $2.00 in advance and $3.00 at the door. Tables are $3.00 for each 4-foot length; reservations will be accepted until October 1, 1982. Since all facilities will be indoors, the hamfest will be open rain or shine, beginning at 8:00 am. There will be prizes, food, commercial exhibitors, a "happy hour," and free parking. For table reservations, send a check payable to KMRA Club, PO Box 411, Waukesha WI 53187.

NEW ORLEANS LA
OCT 16-17

The New Orleans hamfest-computerfest, Amacom '82, will be held on October 16-17, 1982, at a new location, Delgado Community College, near City Park, New Orleans LA. Admission is $3.00 per person over 12 years old. There will be exhibitors, a flea market, forums, ladies' activities, prizes, and a discussion on international broadcasting by the owner of the nation's only commercial shortwave radio station. Amateur radio tests will be given Saturday morning by the FCC. Talk-in on 147.285/.885 and 449.0/444.0. For more information, and reservations for FCC tests, write W. D. "Bill" Bushnell WA5MJM, Amacom Chairman, c/o Jefferson Amateur Radio Club, PO Box 73665, Metairie LA 70033, or phone (504)-887-5022.

ANDERSON IN
OCT 17

The Madison County Amateur Radio Club of Anderson IN will have a hidden transmitter hunt on October 17, 1982. The starting point will be the Mounds State Park near Anderson. Prizes will be awarded. For more information, contact Frank Dick WA9JWL, 921 Isabelle Drive, Anderson IN 46013, or phone (317)-642-1237.

CHICAGO IL
OCT 17

The Chicago Citizens Radio League will hold its first annual hamfest on October 17, 1982, at the North Shore American Legion Post, 6040 N. Clark, Chicago IL from 7:00 am to 4:00 pm. Due to limited table space, table reservations must be made in writing to Fred Marlette KA9FUO 1851 W. Chase, Chicago IL 60626.

CHELSEA MA
OCT 17

The 19-79 Repeater Association of Chelsea MA will hold its annual flea market on Sunday, October 17, 1982, from 11:00 am to 4:00 pm (sellers admitted at 10:00 am), at the Beachmont VFW Post, 150 Bennington Street, Revere MA. Admission is $1.00. Sellers' tables are $6.00 in advance and $8.00 at the door, if available. Talk-in on .19/.79 and .52. For table reservations, send a check to 19-79 Repeater Association, PO Box 171, Chelsea MA 02150.

CHATTANOOGA TN
OCT 23-24

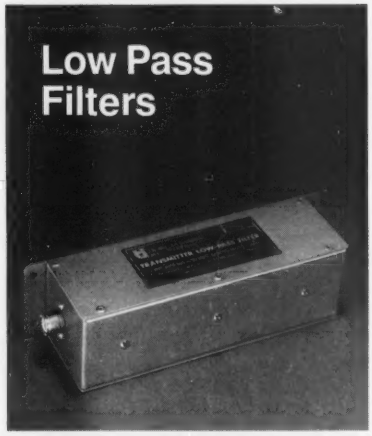
The Tennessee State ARRL Convention will feature Hamfest Chattanooga, to be held on October 23-24, 1982 at Chattanooga State Technical Community College, Amnicola Highway, Chattanooga TN. Admission is free. There will be top prizes, acres of free parking, indoor and outdoor flea markets, and a spacious dealer area inside the physical education building. Other features will include a hospitality party, a Wouff Hong ceremony, ladies' and children's activities, and a cafeteria serving breakfast and lunch. Talk-in on 146.19/.79. For further information, write Hamfest, PO Box 3377, Chattanooga TN 37404.

SAVANNAH GA
OCT 23-24

The Amateur Radio Club of Savannah will hold a hamfest on October 23-24, 1982, at the National Guard Armory, Eisenhower Drive, Savannah GA. Tickets are $2.50 in advance and $3.00 at the gate. Tables are $7.00 for the first table and $5.00 for additional tables. There will be dealers, door prizes, a flea market, and refreshments. Talk-in on .37/.97 and .28/.88. For further information, write Amateur Radio Club of Savannah Hamfest, PO Box 13342, Savannah GA 31406.

FRAMINGHAM MA
OCT 31

The Framingham Amateur Radio Association, Inc., will hold its 7th annual fall flea market on Sunday, October 31, 1982, at a new and larger location (diagonally across from the previous location) at the Framingham Civic League Building, 214 Concord Street (Route 126), downtown Framingham MA. Doors will open at 10:00 am but sellers may begin setting up at 8:30 am. Admission is $2.00; tables are $10.00 and pre-registration



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is strongly encouraged. There will be radio equipment, computer gear, food, and bargains. Talk-in on .75/.15 and .52. For more information, contact Ron Egalka K1YHM, 3 Driscoll Drive, Framingham MA 01701.

MARION OH
OCT 31

The Marion Amateur Radio Club will hold its 8th annual Heart of Ohio Ham Fiesta on Sunday, October 31, 1982, from 0800 to 1600 hours, at the Marion County Fairgrounds Coliseum, Marion OH. Tickets are $3.00 in advance and $4.00 at the door. Tables are $5.00. Features will include prizes, a large parking area, and food. Talk-in on 146.52, 147.90/.30, or 223.34/224.94. For more information, tickets, or tables, contact Paul Kilzer W8GAX, 393 Pole Lane Road, Marion OH 43302.

SELLERSVILLE PA
NOV 7

The R. F. Hill ARC will hold its 6th annual hamfest on November 7, 1982, in the Sellersville National Guard Armory, Sellersville PA. Doors will open at 7:00 am for sellers and 8:00 am for buyers. There will be prizes, refreshments, and heat. Talk-in on .28/.88 and .52. For further information, contact R. F. Hill ARC, Box 29, Colmar PA 18915.

CONCORD NC
NOV 7

The Cabarrus Amateur Radio Society, Inc., will hold its annual hamfest on November 7, 1982, from 9:00 am to 5:00 pm, at the Concord Boys Club, Spring Street, Concord NC. Admission tickets are $2.50 in advance, $3.00 at the door. Flea-market tables are $4.00; table space is $2.50. There will be prizes, bingo for the ladies, speakers, and forums. Hot food, beverages, and free parking will be available. Talk-in on 146.655. For advance tickets, flea-market tables, or space, send a check to CARS, PO Box 1290, Concord NC 28025.

NORTH HAVEN CT
NOV 7

The Southcentral Connecticut Amateur Radio Association's (SCARA's) third annual electronics flea market will be held on Sunday, November 7, 1982, indoors at the North Haven Recreation Center on Linsley Street in North Haven CT. Regular admission is $1.25; children under 12 with an adult will be admitted free. Sellers' spaces are $6.00. The best spaces will be assigned first. A limited number of free tables will be provided to the first reservations received. When those tables are gone, space will be available for selling from the floor or from your own table. Food will be available. Sellers may set up at 8:00 am, and walk-ins will be admitted from 9:00 until 3:00. For reservations, send check or money order payable to "SCARA" to Ed Goldberg WA1ZZO, 433 Ellsworth Avenue, New Haven CT 06511. Include an SASE for confirmation.

BANGKOK THAILAND
NOV 12-14

The Radio Amateur Society of Thailand (RAST) will hold the 12th annual South East Asia Network Convention (SEANET 82) on Friday, Saturday, and Sunday, November 12-14, 1982, at the Imperial Hotel, Bangkok, Thailand. There will be lectures, discussions, and commercial exhibits. For more details, contact RAST Secretary, PO Box 2008, Bangkok, Thailand.

NEWMARKET ONT CANADA
NOV 13

The York Region ARC will hold its annual flea market on Saturday, November 13, 1982, from 0800 to 1400 EST, at the Newmarket Community Centre, Newmarket, Ontario. Doors will open at 0630 for exhibitors. General admission is $2.00 (children will be admitted free of charge if accompanied by an adult). Refreshments will be available. Exhibitors' tables are $2.00 each. Talk-in on 142.52 (VE3YRA) and 147.225/.825 (VE3YRC).

FORT WAYNE IN
NOV 14

The Allen County Amateur Radio Technical Society, Inc. (AC-ARTS), will hold the 10th annual Fort Wayne Hamfest on November 14, 1982, at the Allen County Memorial Coliseum, Fort Wayne IN. Admission is $2.50 in advance and $3.00 at the door; children under age 11 will be admitted free. Regular tables are $6.00 and premium tables are $20.00. The Coliseum charges a $1.00 parking fee. Doors will open to the general public at 8:00 am and for vendor setups at 5:00 am. For further ticket or table information, write Becky Skinner KA9GWE, 9720 Pinto Lane, Fort Wayne IN 46804.

GREENSBORO NC
NOV 27-28

The Greensboro Amateur Radio Club will hold the second annual Greensboro Hamfest on November 27-28, 1982, at the National Guard Armory, Greensboro NC. The hours will be 9:00 am to 5:00 pm on November 27th and 9:00 am to 3:00 pm on November 28th. Pre-registration before November 12, 1982, is $3.00 and registration at the door is $4.00. There will be tables and tailgating available. Talk-in on 145.25, .19/.79, and .52. For pre-registration (please include an SASE) or more details, contact Russ Brandt KE4KL, 1301 Dayton Street, Greensboro NC 27407.

STONY BROOK LI NY
NOV 28

The Radio Central Amateur Radio Club will hold its fourth annual Ham-Central, 1982 edition, on Sunday, November 28, 1982, in the main social hall of Temple Isaiah, 1404 Stony Brook Road, Stony Brook LI NY (about 50 miles east of New York City). Doors will open at 7:30 am for sellers and dealers and at 8:30 for the general public. Admission is $2.00 and XYLs and children under 12 will be admitted free. Nine-foot tables are $5.00 each and half tables are $3.00. Features will include an updated antenna lecture by Art (W2LH) and Madeline (W2EEO) Greenberg, door prizes, and home-cooked hot food and drinks. Talk-in on 144.550/145.150 (WA2UEC) and 146.52. For additional information, maps, and advance reservations, contact Scotty Policastro KA2EQW, 80 7th Street, Bohemia NY 11716, (516)-589-2557; or Bob Yarmus K2RGZ, 3 Haven Court, Lake Grove NY 11755, (516)-981-2709.

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11308	28	1.71	1.52	1.38
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11203	16	.21	.18	.16
11204	18	.24	.21	.19
11205	20	.27	.24	.21
11206	22	.30	.26	.23
11207	24	.33	.30	.25
11208	28	.38	.34	.29
11209	40	.53	.45	.40

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13829	CB3804	3.0-7.0	28±0.7	0-10	.48x.51x3.05	7.95
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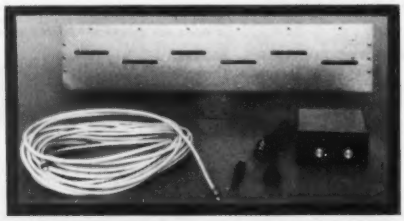

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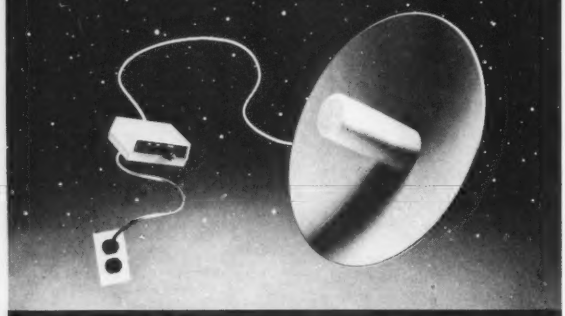

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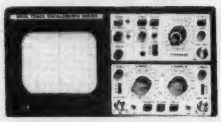

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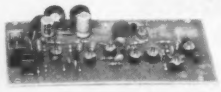

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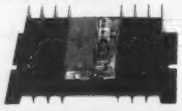

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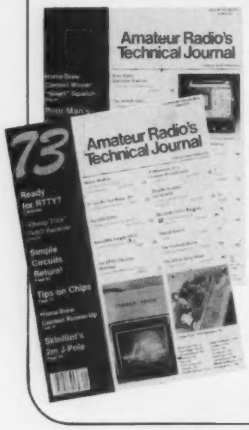

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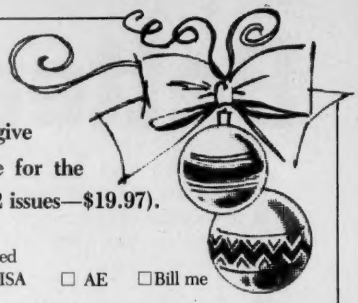

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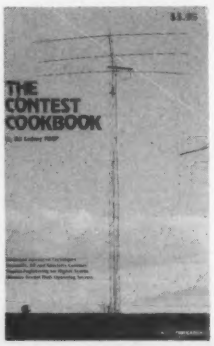

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W2NSD/1
NEVER SAY DIE
editorial by Wayne Green

from page 8

wasn't much I could tell from them. They seemed to indicate that Read, operating under the name of Global Communications (thought that was RCA!), had a contract with Chile to run propagation tests using the ham bands from San Felix. The payment: $25,000. Not bad pay for making 700 ham contacts!

The Chileans are saying that he was never there. Well, having seen people get bum raps before, I kept my mind reasonably open and asked our people to try to reach Read. No luck. The phone numbers on the Global Communications letterhead were disconnected with no forwarding numbers. The phone company had no listing for the firm. The letter was mailed from Greece, with no address or phone number.

Then came a coincidence. I really enjoy it when something happens which would be laughed at in a fiction story because it is too pat. This time I was talking with a chap who runs a ham store and we were discussing some of the times when hams had paid him off with bad checks. He told me a most interesting story about a chap who had bought a hand transceiver and paid for it with a rubber check. It looked strange to him when the chap was unable to produce a driver's license, but he had a company letterhead for Global Communications. "Hold it!" I yelled.

I had him run over the story again after telling him about Bob Read and the CE0X story.

It seems that when the check bounced back from a closed account, they had tried two Global Communications phone numbers... disconnected. Then a couple years later, one of the salesmen in the store recognized Read when he came in. The word was quietly passed. Read wanted to buy a duplexer. This had to be ordered, so they took his order and promised shipment. Global Communications again. Instead of shipping a duplexer, they made up a box the right size and put a piece of wood in the top with the duplexer knobs glued down on it so it looked as if there were a duplexer in the box on casual inspection. They weighted the box so it would feel right, mounted the old bounced check inside, shipped it to Global, and awaited results.

A few weeks went by and then one morning there was a long-distance call from Saudi Arabia and a barely audible voice yelling, "You guys are going to be sorry!"

The next day a chap came in needing a duplexer immediately. Seems his friend was in Saudi Arabia and he had promised to deliver one there; he had to ship it over by air that day. He paid cash, you may be sure.

I looked up the call KF1O in the *Callbook*, but it isn't listed. The store owner involved had the idea that the chap wasn't really a ham but was just pretending to be. That might take some checking. His letter from Greece included a QSL card with the call.

Now, it may well be that there are some explanations for all of this. If so, I'm sure many of you join me in being curious about them. Just on the surface, from what I've heard and read, it sure is curious.

Notes keep coming in about good old Mr. Read. Either he has the worst press agent since Don Miller or else he is a bunch of bad news. I wish we could locate him to clarify reports of skipping bail on bad check charges, of unpaid-for Collins rigs, unpaid-for airline tickets, unpaid-for leased Mercedes, and things like that. Does anyone know where we can reach KF1O so we can get the straight story on all these mounting charges? Read must be one hell of a smooth talker if there is any truth to all these reports.

UNTOLD WEALTH

Well, it looks as if I've struck again. The TVRO material in *73* can, if you find yourself getting interested in it, lay the groundwork for getting into what is going to be a huge industry within a few years. I'm referring to the coming direct television broadcasting from satellites.

Sometimes I get discouraged. On the one hand I get letters from readers who thank me for getting them into new businesses such as home security, computers, and so on, telling me that I provided the impetus to get them going and that they've done well. Indeed, many have become wealthy. But then I still get letters saying that some poor reader can't afford a subscription. Now, with all that money out there just waiting to be grabbed, how can anyone be short of cash?

There are so many businesses that you can start at home, on your own time, with a very small investment, that one has to be awfully lazy to miss out. I suppose it is easier to make do with very little money and enjoy watching television rather than working one's butt off to start a home business. It *is* work, have no doubt about it.

There are still almost unlimited opportunities to sell security systems and service them. The computer field is still in its early stages of growth. I know someone setting up home sales of turnkey computer systems where it's possible to make about $2,000 profit on each sale... and *any* small business in the area is a good prospect for a sale. Now we're beginning to see the proliferation of software stores, something I predicted several years ago. Two outfits are already franchising them... and there will be more.

Once we start seeing direct television broadcasts from satellites, we are going to see billions of dollars in equipment sales and in service contracts. Knowing this, I assume that many readers of *73* will yawn, pick up a beer, and turn to the cable 24-hour-a-day sports channel. Well, the gold goes to those who go get it. The articles in *73* can, if you start paying attention to them, help to give you some of the experience you will need to cope with direct broadcasting.

SOMEONE NEEDS HELP!

Almost every part of our country is covered by at least one repeater, so when you think about it, we already have the backbone for a wonderful emergency alerting system. The communications medium is there, ready for use 24 hours a day, in good propagation or bad. We're just not using it with much efficiency.

Any of you who have spent many hours monitoring a repeater channel know why most of us do not do it. Talk about boring! With all due lack of respect, a conversation about where some mobiling ham is located at the moment may be fascinating to him, but not to anyone else. Long discussions about signal strengths fall kind of flat, too, particularly when the second station in the contact is only making the repeater a tenth of the time.

Then there are those never-ending tries at autopatching from a station just a bit out of range. Well, you know why *you* don't listen to the local repeater very often.

Before you get mad at me for putting two-meter ops down, let me explain that one of the reasons I'm not heard all that often on repeaters is that I've found that I fall into the same bad habits when I call in. I drive rather vigorously and thus have to put most of my concentration on my driving. The shreds of my brain left to handle my two-meter contacts are not enough to dredge up much in the way of interesting talk. I can talk or I can drive, but I can't do both with brilliance and neither can many other people, judging from what I've heard.

Okay, if we are going to monitor a repeater all the time so that we will hear the alerting call when it comes through, we are going to have to put in some sort of automatic alarm system. And if we are going to interest many hams in participating, it is going to have to be relatively inexpensive.

First, let me say that I'm wide open for any ideas for such a system. I'd love to have someone invent it and write it up for *73*. If you do, I'll try to find a manufacturer for it... with a royalty for you. Lacking that, perhaps one of the firms in the ham field will come up with a simple alerting system, in which case I'll still be interested in publishing articles on it and helping them sell the gear.

Thinking about what kind of system might fit the bill, I note

that many of us seem to spend the few bucks extra to put a touchtone pad on our HTs. TT decoder chips are not terribly expensive, so perhaps a little IC decoder can be made which will do the job. It could even be powered by the audio output of a rig and be flipped on with a certain set of tone signals.

If I were sitting in my lab building the project, I would design it to ignore any tone signals other than the wanted ones. Let's say that we decide on using the #2 and #3 keys, the "C" and "D" keys, if you will, since CD is not difficult to remember. Our decoder would ignore any tones not starting with a #2, thus keeping down the falsing. A system which gives false alerts is not going to be of much value.

That's just one idea...with the concept of keeping the whole system as simple as possible and yet relatively false-proof. If you have what you think is a better idea, why not put a unit together, test it out, and write an article on it?

I hope there is no argument about the need for a universal alerting system. Not only is this needed for local emergencies, but for national drills. There *should* be some way of getting in touch with *every* member of a repeater group, night or day, at home or at work.

S-9 GONE, TOO

Cowan Publishing, which for years published *CQ Magazine* and *S-9*, recently turned *S-9* over to another magazine to fulfill the circulation responsibilities. That's about the end of Cowan, I think.

CQ, which was in its heyday in the late 50s, was owned by a non-ham and run as a family business. It was losing money in January, 1955, when I came on as editor. Within a few months, by changing the magazine from a column-oriented publication to an aggressive magazine for builders, I got it into the black. Indeed, by 1959 I had it going so well that it made over $100,000 in profits, which was a good deal of money for those days. Publishing *can* be very profitable.

After several battles over trying to get them to pay my authors for articles, I was finally fired in January, 1960. I had checked the books and found them to be as much as a year and a half behind on paying authors, with few paid within a year of publication. I ended up having to pay for material out of my own pocket (for which I was never reimbursed, despite promises...a loss of about $10,000 ...which also was a lot of money back then) in order to keep the magazine going.

That's when I started *73* and aimed it at doing what I had wanted to do with *CQ*...get hams interested in building. *CQ* went back to monthly columns, with little in the way of articles and circulation gradually dwindled down. Insiders told me that their circulation had dropped well below 10,000. Every now and then Cowan would write an editorial saying that he had neglected *CQ*, but that all that was changed and it would be made better. Nothing happened. Eventually he got tired of the losses and "sold" it to his editors.

S-9 went the same route, essentially. It just gradually faded away of neglect. Funny thing, for when CB was riding high, I was under a great deal of pressure from my advertising sales manager to start a CB magazine. I didn't believe that CB would continue its popularity, so I held back. Good move.

S-9 was absorbed by *CB Magazine*. Oh, it has a recent new name, but I forget what it is. It's improved of late due to the entry of Gordon West. It's now a sort of combination CB, SWL, pre-Novice magazine.

I think we learn more from the screwings we get than from our successes. I know that I sure learned how *not* to run a magazine from Cowan...and perhaps that was worth the year's pay he still owes me.

REVIEW

THE ICOM IC-730 HF TRANSCEIVER

The Icom IC-730 HF transceiver is the product of an engineering philosophy dedicated to offering as much radio in as small a package at as low a price as is feasible. Icom currently offers two HF transceivers (the other is the IC-720A), but the design concepts behind the IC-730 more closely resemble the no-longer-available IC-701 than they do the IC-720A. Because of this, we'll be comparing the IC-730 primarily to the IC-701.

Sitting flat on a table, the IC-730 measures just over 4 inches tall, 9½ inches wide, and 10¾ inches deep, making it considerably smaller than either the IC-701 or the IC-720A. In addition to its unique features, it offers the usual amenities we have come to take for granted in an HF transceiver: RIT, rf gain control, digital readout, speech processor, VOX, fast/slow agc, noise blanker (with two widths), i-f shift, and a full 100 Watts output (minimum) from the same finals that were used in the IC-701. No tune-up peaking or tweaking is necessary in either transmit or receive mode. On the bandswitch, AM is present along with SSB, CW, and a narrow CW position. The front panel is well laid out, a factor of great importance to both the dedicated DX-hound and the mobile operator.

Special Features

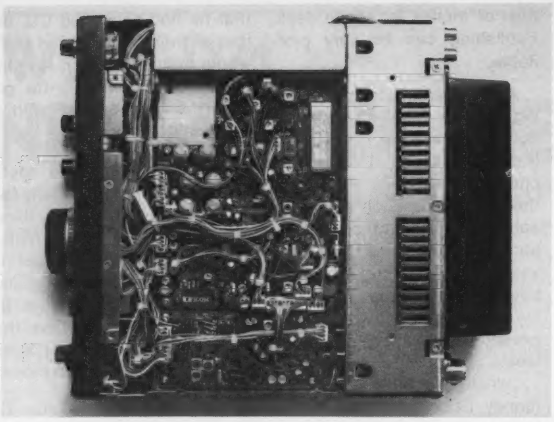
Like the IC-701, the 730 sports fully synthesized tuning. Three interlocking push-button switches to the right of the main tuning knob select the tuning rate, which can be in 1-kHz, 100-Hz, or even 10-Hz steps. While some prefer continuous tuning, we feel that the many advantages of step tuning far outweigh any of the supposed disadvantages. The 10-Hz-per-step tuning makes for a positively luxurious bandspread—one complete revolution of the tuning knob changes frequency by only 1 kHz! When speed is of the essence, selecting the 1-kHz-per-step rate will allow you to get from the low end of the CW band to the high end of phone in two seconds flat.

Just beneath the tuning rate switches is the LOCK switch which electronically locks the 730 on the displayed frequency. Engage it and the main tuning knob is disabled. If you've ever bumped the vfo knob just as a rare DX station returns your call, you'll appreciate this feature! The RIT control operates even when the LOCK is on.

Icom transceivers are famous for their dual vfo's, so there are no surprises here. The IC-730 has two vfo's controlled by a four-bit microprocessor. They can be used separately as memories, keeping track of activity on two different frequencies, or they can be used together for split RX/TX operation. When you consider how much you normally pay for an external vfo, you begin to realize how much of a bargain the IC-730 really is!

There is also a separate memory for each band which can be programmed independently of either vfo. We've used virtually every HF rig which incorporates memory functions, and the IC-730 is the first unit we've seen

Front view of the IC-730.



Top view of the IC-730. Note liberal use of wiring harnesses and plug-in connectors.

which forced us to get out the manual to help figure out memory function. Fortunately, once you read through the examples, all becomes clear. Perhaps rewording the front-panel labels would speed comprehension! If you often operate on specific frequencies, you'll appreciate the memory backup feature. As long as there is 12 V at the memory backup connection, the memories are not lost when power is shut off.

As is becoming common these days, metering is sparse. The IC-701 allowed you to view S-units, ALC, compression, collector current, voltage, and rf output. With the IC-730, you'll have to make do with ALC and rf output.

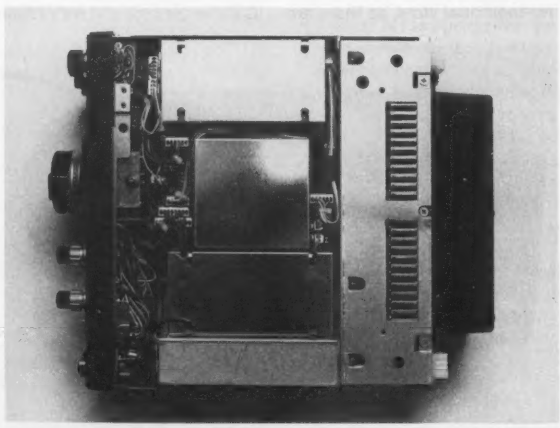
An extremely welcome innovation is the built-in preamp. While this may appear to be a gimmick, anyone who has used a good preamp can attest to its usefulness. The preamp is located between the low-pass filters and bandpass filters, and, when switched in, exhibits about 12 dB of gain.

The IC-730 covers all ham bands between 80 and 10 meters, with generous amounts of coverage above and below each band. Our sample tuned everything between 3.4 and 4.01 MHz, 6.9 and 7.6 MHz, 9.9 and 10.6 MHz, 13.9 and 14.6 MHz, 17.9 and 18.6 MHz, 20.9 and 21.6 MHz, 24.4 and 25.1 MHz, and 27.9 and 30.1 MHz. The 10-meter band has four separate sections on the bandswitch.

The microphone connector is an eight-pin affair with pins to allow up and down scanning with a push-button microphone. Much to our surprise, the wiring diagram in the manual includes only the pinouts for PTT and audio. Icom apparently feels that hams cannot be trusted to wire their own scanning microphones! The scanning capabilities are convenient for hams who wish to remote-control the rig for some reason, and it's a shame that Icom didn't come right out and tell us which pin does what. If you intend to use these pins, make sure you know exactly what's what. Short the wrong pins and you'll watch blue smoke curling into the air!

Several controls are hidden away beneath a small port on top of the rig. Theoretically, these are controls which seldom need adjustment. There are pots for sidetone audio level, anti-VOX, VOX gain, VOX delay, frequency calibration, and swr set. There are miniature slide switches for noise blanker wide/narrow, speech processor on/off, and swr forward/reflected. Icom's judgment was sound on all but the speech processor. We'd really prefer to have that switch located on the front panel, particularly since the access port will be completely inaccessible in most mobile installations. On the bright side, Icom's speech processor is exceptionally clean and distortion-free. If properly adjusted, there is no reason why it can't be left on all the time.

On the left side of the rear panel are the power socket, ground connection, and antenna connector. The middle area is occupied by the heat sink and fan for the final amplifier. On the right side is a jack that can be wired for either memory backup or amplifier relay switching. There are also jacks for ALC input, speaker output, CW key, and a multi-pin accessory socket with all the necessary signals available for transverters, phone patches, and band-switching for the IC-2KL linear amplifier. There is no direct access to the microprocessor as there was with the IC-701.



Bottom view of the IC-730. Note the extensive internal shielding.

Inside the IC-730

The layout inside is light-years ahead of its predecessor. There is liberal use of small boards interconnected with plugs and jacks, making servicing easier on everybody. A great deal of internal shielding is employed, which probably accounts in part for its immunity to RFI from microcomputers.

The instruction manual is reasonably good, although it is obviously targetted at the appliance operator. Some Japanese manufacturers (like Yaesu) are including more and better service information with each new rig they introduce. Icom seems to have taken a step backward, for the manual supplied with the IC-730 is not as complete as the one we received with our IC-701! The IC-701 was supplied with charts of voltage readings at critical locations and more or less complete sections on theory of operation and alignment. No alignment instructions are furnished with the IC-730, and the circuit description is not particularly informative since no mention is made of specific components. Fortunately, there is a large fold-out schematic, and an even larger board layout diagram. Emergency repairs could probably be made from this information, but hams planning to take on their own maintenance and repairs by choice or necessity would do well to pester Icom America for more complete service data.

The Power Supply

Our review sample was supplied with the IC-PS15 power supply, rated at 12 V dc and 20 A, with a 10-minutes-on, 10-minutes-off 50% duty cycle. It is well regulated and probably adequate for casual operators, but contesters and serious CW operators might do well to look into a heftier supply. As is the case with many 12-volt power supplies from transceiver manufacturers, the PS15 is designed to work only with the rig it matches, so it can't be used with other station equipment. Moreover, it only superficially matches the rig in appearance and lacks the traditional front-firing speaker. Considering the price tag, a hefty well-regulated 20- or 30-Amp supply from a reputable power supply manufacturer might be a better choice.

Accessories

The IC-730 is supplied with a preamplified hand microphone, a bag of plugs, and a hefty dc power-supply cable. Accessories available at extra cost are a marker unit with output every 25 or 100 kHz, a 500-Hz CW filter, a CW audio filter, full passband tuning, base station microphone, scanning hand-held microphone, mobile mounting bracket, external speaker, phone patch, and power supply.

On the Air

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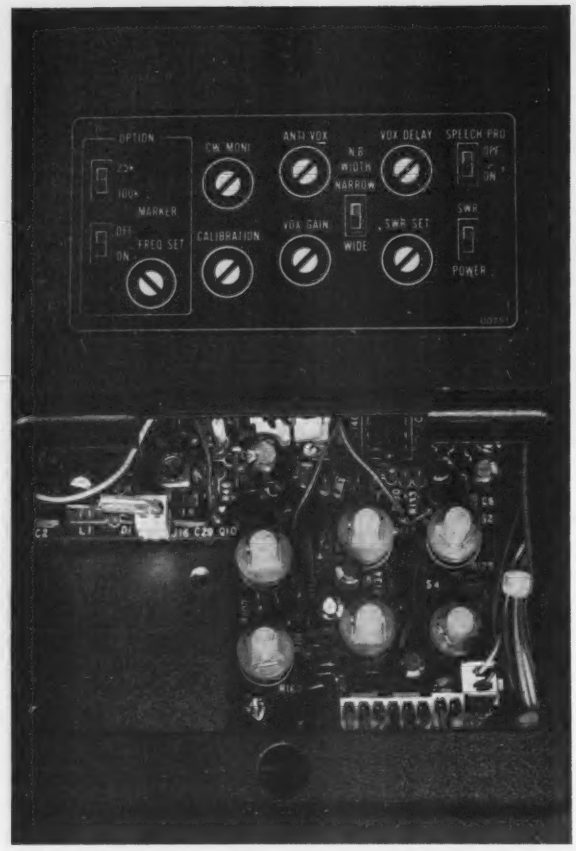

Access port on top of unit. Blank space in bottom left corner is for optional marker unit.

concerned about the quad-conversion design and birdies, but the 730 uses up-conversion with i-f's at 39.7315 MHz, 9.0115 MHz, and 455 kHz, reducing these problems to a minimum. Careful listening without an antenna turned up a couple of weak birdies inside the ham bands, but they didn't even move the S-meter. Outside the ham bands, we found only a few louder signals, ranging from S-3 to S-5. Not bad!

RTTY operators should note that the IC-730 is very well protected against RFI from microcomputers. With an antenna located some distance away, we placed the 730 three inches away from a disk-equipped TRS-80 Model III and heard no RFI at all. Most other rigs we've tested suffer varying levels of interference under these conditions.

Received audio quality is excellent, and there's lots of it. We used the IC-730 in a noisy car for several weeks without any external speaker, and it was fine. There seems to be more high-frequency audio available than there was in the IC-701, which makes speech easier to understand. As with every other rig we've tested, lots of internally-generated hiss and noise can be heard, even when no antenna is connected. Transmit audio was excellent, with most other hams reporting that audio quality was best with the speech processor in the "on" position. On the negative side of the ledger, the cooling fan runs continuously in the transmit mode, and also in the receive mode if the rig is overheated. We found noise from the fan slightly annoying in a quiet room, although it is much quieter than the fans in high-power amplifiers.

As for general receiver performance, the IC-730 seems to be more sensitive than the IC-701, and audio quality is substantially improved. Dynamic range was quite good, too. Serious CW operators will probably not be happy until they install a CW filter, however.

We really don't enjoy torturing equipment, but we felt obligated to run a few tests in the interest of science. With the rig in the transmit mode at full output, we flicked off the power switch and turned it back on again a few seconds later. Another solid-state transceiver we were considering for review blew an internal soldered-in fuse when subjected to this treatment. It took an hour to find and replace! The IC-730 (and the PS15) showed better manners and never missed a beat. While some might consider this test unreasonable, it is vital that a rig be able to pass it if it is expected to operate under emergency conditions.

To test the swr protection circuitry, we transmitted into a variety of less-than-perfect loads. We also tried a couple minutes of transmission with no load at all. No problems developed. We performed similar tests on our IC-701 when we first received it, and after three years of hard use, often under less than optimal conditions, the original finals are just fine, thank you! While there is undoubtedly a particular combination of load, rig, and idiot that will blow the finals, all indications are that the IC-730's final amplifier will be highly reliable.

Hams who find an attenuator indispensable should be aware that there is none on the IC-730. In all fairness, we must say that while we have encountered many operators who have professed great regard for these devices, we have never seen them actually use one on a modern rig!

Conclusions

Several months of use have left us with nothing but respect for Icom's compact HF transceiver. Indeed, returning it leaves us with a feeling of great loss! The only thing we'd like to see added is a good notch filter and perhaps a RTTY input for direct FSK. Practically speaking, though, neither of these are available on other compact transceivers.

For our style of operation, the IC-730 is one of the best transceivers we have yet encountered, regardless of size or price. Most intriguing of all, it appears as though the little IC-730 might stand up well to the rigors of DXpeditioning. If you are looking for a small transceiver but are unwilling to compromise on performance or give up features, the IC-730 deserves serious consideration. For more information, contact *Icom, 2112 116th Ave. N.E., Bellevue WA 98004.*

Paul Grupp KA1LR
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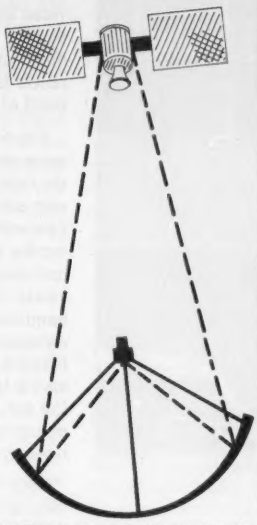

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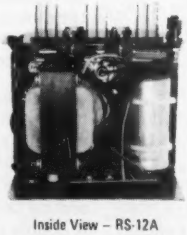

Inside View – RS-12A

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Spider antenna from Multiband.

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Jim Gray W1XU
***73 Magazine* Staff**

MULTIBAND ANTENNAS

The first time I saw the Spider antenna, I was intrigued with the unusual design and wondered why anyone would put something like that on a car. The location was San Diego, and the event was the ARRL Southwestern Division Convention and "Hamputer" fest.

Fred Schmitka of Multiband Antennas had a booth there, and he had several of these mobile antennas conveniently mounted at the booth which caused a lot of gawking and a lot of stopping to question Fred all about the whys and wherefores. I was one of the stoppers and gawkers, too, and learned that Fred and his brother Len have spent several years perfecting—and patenting—the Spider.

Basically, the Spider is a mobile antenna that permits operation on 10, 15, 20, and 40 meters from your car. The antenna consists of an aluminum (or stainless steel, if you prefer) mast section about four feet high, with four "fingers" protruding from the top at various angles. The 40-meter finger sticks straight up, more or less as a continuation of the mast, while the 10-, 15-, and 20-meter fingers are arranged radially around the mast at about 120-degree spacing, like the spokes of a wheel. Each finger also tilts about 45 degrees from the vertical. These fingers are the resonating elements for the four bands and consist of fiberglass rods or tubes helically wound with wire and covered with a tough, transparent plastic. An index scale is molded into each element so that adjustment to exact frequency can be made. This adjustment is provided by sliding a short tubular section along the resonator element until minimum reflected power is measured at the feedpoint of the antenna.

The big advantage of the four separate resonating elements is the fact that the antenna is fully and automatically bandswitchable without the driver ever leaving his seat. You merely pre-adjust each resonator to your favorite frequency within the band, and that's it. . . or so Fred assured me. He also suggested that the mobileer not use a base spring to mount the antenna on the car, but instead use a solid mount to keep the antenna vertical, even at highway speeds.

Well, I was fascinated by the idea, and Fred kept assuring me that the antenna worked as billed and that the helical resonating elements placed at the top of the antenna provided the highest possible position for maximum current (i.e., top loading, exactly where you want the current maximum in a mobile installation). To make a long story short, I had one shipped to *73* HQ for a test. I also asked Fred to include a bumper mount for my 1980 Olds Omega and a quick-disconnect fitting to prevent unwanted and undesirable removal by my garage door or other low overheads. Of course, Fred didn't have anything that would remind me to remove the antenna before driving in, so that part is up to me. At least I'd be all set to quickly remove the Spider should I remember in time.

The afternoon of the Fourth of July was spent installing the antenna on the car. I made a secure bumper mount, assembled the antenna according to the instructions, and with great trepidation fired up the rig. What's this? Signals coming in at S-9 on 40 meters in mid-afternoon? Hmmm. . . let's try 20. Yep, signals there, too; and on 15, and 10, too.

I connected my swr bridge into the line at the base of the antenna and put a very small amount of rf into the antenna starting with the 20-meter band and my favorite frequency there. A couple of slides of the slider tube and the meter showed zero reflected power. Wondering about possible interaction, I tuned up to 40 in the same way, and then 15, and then finally 10. Fully expecting to have to go back and readjust each one because of interaction, I was amazed to find that the original settings still held and that no retuning was needed.

Now for the proof test. . . the so-called moment of truth. I heard W2JAU in New York calling CQ on 40, so I gave him a quick reply. He came back and said that I was 5-8 in Brooklyn! "Pretty good signal for a mobile," Ben said. "What are you using?" Well, have you ever tried to describe something like a Spider over the air? No? Well, you've got a treat coming. After a nice long, solid QSO with Ben, I decided to try 15. I answered EC4AQS in Spain and OE8LKK in Austria. The Spanish station was very QSB, but we did have a good QSO. The Austrian station was loud, and that QSO was much better. . . but still the band was not in very good shape. Nevertheless, we managed to work out quite well, considering that my driveway is not the best DX QTH in the world. Back to 40 meters, I contacted Bill VE3BDO in Ottawa who was using his recently acquired GFT-ONE. We gave each other 5-8 to 5-9 reports and talked a bit about our new toys.

The rig I used was a venerable TS-520S which didn't even know it was in the car. . . since it loaded just as well as it ever does on the fixed-station antennas. Now to try the bandwidth and how far I could go without exceeding a 2:1 swr.

On 40, I could move close to 50 kHz without exceeding 2:1 vswr. On 15, it was better than 100 kHz, as it was on 10. What about 20, you ask? Well, to be honest, I hadn't tried 20 by the end of the first afternoon; that had to wait for July 5th—another holiday—and results were equivalent to those on the other bands. My first answer brought W8TA in Detroit (short skip QSO) and a 5-7 report. Bill's signal was also about 5-7 to 5-8, and we had a good chat. Bandwidth without retuning the resonators was about 75 kHz. Here it should be mentioned that each resonator is wound long purposely so that resonance can be obtained below the bottom band edge. (This is a feature which appeals to MARS operators. If it is desired to achieve resonance at the top edge of the band, it may

be necessary to remove some turns of the coil.[1])

I should mention that I also chatted with Chuck W2WGL in Utica, New York, on SSB. He gave me a good 5-7 report on 40-meter phone and remarked at the steady signal. Well, it ought to have been... I was parked!

Unfortunately, 10 was not open, so I haven't been able to make any QSOs... but I'll keep trying! With a good band opening, there ought to be plenty of stations willing and able to work W1XU mobile.

One more thing I ought to mention about the Spider antennas... or maybe a couple more things: First, the fact that if you already have a base rod from a Hustler, for example, you can get an adapter from Fred to adapt your base rod to his Spider. It's the economical thing to do and works just great. You can use either antenna whenever you wish... just by changing from one top, or resonating, section to the other. The second thing I want to mention is that the Spider antennas might very well be excellent for use in mobile homes, RVs, apartments, or what have you, where a limited-space antenna is mandatory. One precaution, though: Be sure to use an adequate ground plane... like the chassis of your car. When you don't have such a ground plane, use radials, a railing, a counterpoise, or whatever you can find that will serve the same purpose. One trick passed on to me long ago by a ham whose name I've long since forgotten is to use a piece of four-conductor rotor cable as your ground plane or counterpoise. Just cut each of the conductors, one per band, to the quarter-wavelength-plus-2½ % formula. They really work and provide the much-needed "phantom" antenna. This can be a big help in apartments and condos.

Maybe if the super asks what that funny thing is that is attached to your balcony railing, you can say that it is a clothes-tree. Most of us, however, will find the Spider in use on our vehicles, whatever they may be. Travel trailers are excellent for the Spider, too.

Perhaps the best thing about the antenna is that it can be tuned to your favorite part of the band and forgotten unless you want to really change to another part of the band entirely, in which case you merely adjust the slider. An afternoon of doing a frequency plot vs. index markings on the resonators will arm you with the data you need for almost instant band changing. The reason that Fred and Len don't provide frequency vs. index marking information is because each installation will be different, and what's sauce for the goose ain't necessarily so for the gander. Thus, you'll have to go through the tuning and pruning operation once when you first install the antenna. After that, it's all downhill. Besides, you want to do *something*, don't you?

Finally, I have to say that the workmanship is solid, functional, and efficient. As for beautiful, all I can say is what my grandmother used to say: "Pretty is as pretty does." The Spider is therefore beautiful by definition, because it does pretty well indeed. Don't take my word for it, try one yourself... you'll be glad you did.

For more information, contact *Multiband Antennas, 7131 Owensmouth Ave., Canoga Park CA 91303*. Reader Service number 476.

Jim Gray W1XU
***73 Magazine* Staff**

[1]In my tests I noticed that on 40 meters with the tuning ring slipped all the way to the bottom of the resonator, I could just achieve unity swr at about 7150 kHz. Yet, with the ring only halfway up the resonator, I was able to achieve unity swr at 7.005 kHz. This means to me that there is a lot of room for pruning the resonators so that adjustment of the sliding ring will achieve unity swr at both band edges. To prune, just slip off the plastic cap and carefully peel turns loose. After removing turns, carefully cut the wire and throw the excess away. Tuck the remaining end back into the resonator and recap it.

CUSHCRAFT R-3 HALF-WAVE VERTICAL

We all remember the old cliches about vertical antennas, but the problem is that most of them weren't true. I've used vertical antennas with good success over the years and have owned most of the brands on the market at one time or another.

Oh sure, if you insisted on ground mounting your vertical, refused to place it in the clear, and just drove any old kind of ground rod into the soil instead of furnishing decent radials, you were disappointed... and have only yourself to blame. On the other hand, if you placed that vertical at a decent height, provided a set of radials at the base, and took pains to tune and prune it properly, you had a fine antenna that worked its share of DX.

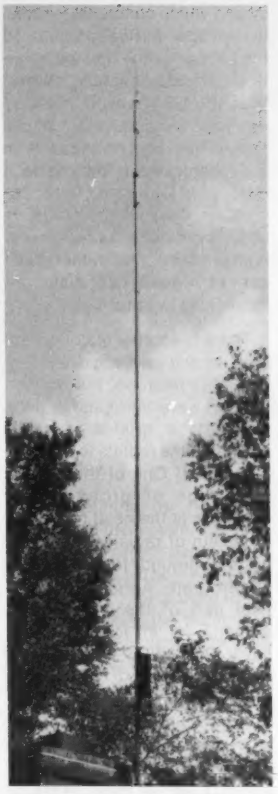
Cushcraft has long been known for its fine line of HF and VHF beam antennas, and there are few of us, indeed, who have not seen or heard them play on the various ham bands. Perhaps fewer of us have seen or used their multiband trapped quarter-wave vertical antennas, and I'm sure that fewer still have really paid sufficient attention to what Cushcraft has accomplished with their new R-3. Believe me, it's a breakthrough!

Let's go back for a minute or two and review what we know about vertical antenna patterns... particularly the best-known and most popular vertical, the quarter-wave ground-plane vertical... to establish a basis for discussion of the R-3.

Most hams turn to verticals as space-saving antennas when they don't have room to erect larger arrays such as horizontal dipoles, beams, extended wire antennas of all kinds, and others that require reasonable (sometimes unreasonable) amounts of real estate to own and operate.

Those who have used verticals with success, including those forced to use them because of space limitations, have discovered that quarter-wave verticals seem to work very well at close distances and very well at long distances. However, at mid-range distances, verticals often don't seem to work as well as conventional horizontal antennas. The reason for this seeming anomaly is the angle of radiation, specifically the vertical angle of radiation.

In order for the normal dipoles and other horizontal antennas to exhibit their best vertical radiation angles, they must be placed at least one half wavelength above the ground surface. The vertical antenna, in contrast, exhibits a very low vertical radiation angle even though its bottom end is resting on the ground. Each amateur band has a different optimum vertical angle of radiation for maximum distance transmission. For example, an optimum vertical angle of radiation for a horizontal antenna on the 20-meter band would be about 10-15 degrees for the best DX. By the time the vertical angle of radiation is as high as 20 or 30 degrees above the horizontal, it has become a mid-range antenna and rather poor for DX. As the frequency becomes higher, the required vertical angle of radiation for best DX performance becomes lower, while the converse is also true.



The R-3 half-wave vertical from Cushcraft.

Thus, for best performance as a DX antenna, a horizontal antenna must not only be physically large and take up considerable space, it must also be high... as most DXers know, the higher the better. On the other hand, vertical antennas with their naturally lower vertical angles of radiation tend to be natural DX antennas. (Be patient, readers, we're almost there.)

VHF mobile operators have found that quarter-wave ground-plane verticals, while adequate for working close-in stations on VHF, suffer when trying to really reach out, because a large portion of the radiated rf is still radiated at angles too high for line-of-sight work. The solution to this problem is the use of gain antennas, antennas which are longer than a quarter wavelength at the operating frequen-

cy and which concentrate radiation at low vertical angles. On the HF bands the half-wave vertical, though slightly shorter than the 5/8-wavelength antenna, has an additional advantage: While most of its radiation is concentrated at low angles, it has a high-angle lobe for medium distance coverage. In other words, the half-wave vertical provides good signal coverage at virtually all distances from close in to far away.

There is another major advantage of the half-wave vertical. Unlike its relatives, the quarter- and 5/8-wave verticals, it does not need a ground plane or ground-plane radials to function at its best! One of the biggest bugaboos of ground-plane antennas is the need to provide a system of radials or a nearly perfect ground for the return current path. Although the vertical part of the quarter-wave antenna is, in fact, a space saver, the radials required tend to offset much of this advantage. Those of you who have wives, mothers, or neighbors who take pride in their homes and in the appearance of the property (as do most hams, of course...ahem) know that radials in the form of wires strung around to the roof edges, adjacent trees, stakes in the ground, etc., are unsightly and inclined to arouse the worst in human nature.

Enter the R-3. Here is a vertical antenna *without radials of any kind* that covers the three most-used DX bands: 10, 15, and 20 meters. The R-3 is a true electrical half-wave vertical radiator on each of these bands. It has two traps which effectively shorten the antenna physically yet permit resonance on each of the bands. Best of all, the R-3 can be tuned to exact resonance at your desired frequency within each of the bands...remotely, right from the shack!

Inasmuch as Peterborough is only a forty-five-minute drive from Manchester, site of the ultra modern Cushcraft manufacturing facility, Bob Cushman and Glenn Whitehouse graciously invited me to pick up the R-3 myself and take a plant tour. After a pleasant and very informative walk around the plant, which included a peek at the antenna test range, the laboratory, and the production lines, I picked up the packaged R-3 in its box, tucked it into my car, and took it home.

Several major groups of components make up the R-3, each in its own container, well protected from damage and almost immune to everything but an intentional effort to destroy. You will find the CTA capacitor/motor unit in its own box, the indicator/control unit in another box, the traps and aluminum parts in the main box, and all of the hardware in a plastic bag...and I mean *tough* plastic. A complete set of illustrated instructions, with exploded assembly views and parts list with picture identifiers, completes the package.

All you need to assemble the antenna is a screwdriver, a small adjustable wrench and/or a pair of pliers, and a tape measure. The base section is assembled first by making up the matching and feed ring and attaching it to the base. Next comes the capacitor box with its internal motor, and finally the traps and aluminum tubing which, when assembled properly, becomes the R-3...all 22 feet of it. I was impressed with the quality of the aluminum, the stainless-steel hardware, the *correct* number and sizes of nuts, bolts, and washers, and the general attention to detail that characterizes this antenna. The instructions are clear and straightforward.

Having learned my lesson long ago to read the intructions first, I spent some time looking at the drawings, reading the assembly steps, and comparing hardware to the lists of same.

Wherever a dimension was given, I followed it meticulously, measuring everything carefully to see that it was correct. With the assembly drawings and exploded views, I am convinced that anyone could assemble the R-3. The entire process of making up the antenna took me exactly one hour and thirty minutes...ready for installation.

I had a chimney mount that used to support my small beam, so I decided to use that...together with a five-foot piece of TV mast tubing to which the R-3 base is bolted. If you prefer to mount your R-3 on some other kind of support, it will fit over any kind of pipe or mast up to a 2-inch diameter. I also had a suitable length of four-conductor rotor control cable salvaged from the former beam installation, so I decided to use that for the control box and remote motor hookup. Please note that when you buy your R-3 antenna at your dealer or when you order it by mail, also be sure to order enough four-conductor cable to reach from the point of installation to your operating desk where the control box is likely to be located.

At this point, I was ready to attach the coax to the antenna, so I chose the right length of RG-58/U (since I run only 200 Watts and don't anticipate using an amplifier) with a PL-259 connector on the end. Cushcraft provides a neat little neoprene sleeve that fits over the coax fitting and also gives you a tube of silicone grease to waterproof the coax connection at the CTA box. I would also recommend that you tape and waterproof the control cable connection at the connector block...just to be safe.

A quick once-over and I was ready to apply power. The control box did move the indicator needle back and forth across the dial...from below the 20-meter band markings to above the 10-meter band markings, so apparently the capacitor was moving correctly in its box. I returned it to the 20-meter position and decided to try that band first.

My swr meter was connected in the circuit, so I applied rf power to the antenna at the low end of 20 meters while I moved the switch to resonate the antenna, i.e., tune it to frequency. Suddenly, the swr began dropping, and dropping...and dropping. It fell *below* 1.1:1! Then, just as quickly, it began rising again, so I knew that I had passed the point of resonance. Unable to resist temptation, I switched back to the point of lowest reflected power, made a quick call, and raised K4OAH. "Five, nine, nine here in Atlanta, OM," came the report. After a brief chat, I moved on, working several US and foreign stations in quick succession, receiving *very* gratifying reports.

The 15-meter band didn't seem to be so hot, but I tried anyway, figuring that even if I didn't raise anyone, I could at least check out the tuning range of my R-3. Again, with actuation of the switch on the control box, I watched the swr drop further and further...and, again, it stopped below 1.1:1! What the hay, as long as I was tuned up on 15, why not call into a dead band? It couldn't hurt. Believe it or not, K4CG answered me and gave a 589 report in Alexandria, Virginia.

The R-3 was beginning to make a believer out of me.

On 10 meters, which *was* closed, I did manage to tune up as before, with the same results...and an swr below 1.5:1 at resonance. You ought to know that the instructions are very explicit about tuning, and they mention that if the antenna can't be resonated to less than 1.5:1 at the upper and lower ends of each band by merely tuning the capacitor through the control box, then you will have to change the length of the antenna slightly...all of which is carefully explained.

I figure that mine worked at the specified dimensions with no changes from the nominal ones given in the instructions because it was mounted high and in the clear, without the length-changing influences of nearby trees, wires, and ground.

To date, I have had an opportunity to use the R-3 antenna on both phone and CW in various parts of the bands and have found it unquestionably superior to my regular quarter-wave trapped vertical in terms of the signal reports that it delivers and especially in hearing signals. Being tunable to exact resonance, it tends to filter out unwanted portions of the band by exhibiting a high Q factor. I have particularly noticed its ability to hear mid-distance stations as well as DX at the same time and to work equally well on short skip and long-haul communication.

Not having a beam, but having various horizontal and vertical antennas for comparison, I can truthfully say that my R-3 outperforms them all in both received and sent signal reports. As the old saw goes, "You can't work 'em if you can't hear 'em," so the rest is up to me. No more excuses for not getting the rare ones. By the way, that brings up an interesting point: I worked VE1SPI on St. Paul with the R-3 antenna, on 15 and 20. Better still, I got them on the *first* call...in itself a relatively rare experience for me.

Is there anything that I didn't like? To be honest, no, there is not. You have to be careful in hooking up the remote control

cable, and be sure you correctly identify which pin is which, because it will not work if you don't. Also, you have to be careful in putting up an all-metal antenna of *any* kind to prevent contact with power lines and the like. I would also highly recommend that you connect a surge protector in your coax line to bleed off accumulated static charge and minimize the possibility of a lightning strike.

To sum it up, then, I have to say that the Cushcraft R-3 packs a powerful punch in its slim and trim length, and I recommend it highly to anyone who needs a good antenna that can be erected almost anywhere *without* radials and turn in unsurpassed performance for a vertical.

For more information, contact *Cushcraft Corporation, 48 Perimeter Road, Manchester NH 03108*. Reader Service number 480.

Jim Gray W1XU
***73 Magazine* Staff**

KTI-20 POWER SUPPLY

A power supply isn't a glamor item. If it does what it should do, supply a regulated voltage at its rated current, you should be able to ignore it and concentrate on the device that is being powered. The Kem-Tron Industries KTI-20 power supply isn't glamorous and it can be ignored once safely installed in the shack.

The KTI-20 is a 13.8-volt, 20-Amp regulated supply. Its 20-Amp rating means that it isn't quite big enough to power a 200-Watt solid-state HF rig, but it will do very nicely as a supply for just about any less-current-hungry rig in your shack. The supply uses an LM723 regulator driving four pass transistors and contains a crowbar protection circuit that will shut down the supply if a regulator failure should cause the output voltage to rise above a safe level. The output voltage is variable plus or minus about ten percent around the nominal 13.8 volts.

I've used the KTI-20 in my shack for some time to power my 2m rig and, occasionally, a 160-Watt 2m amplifier. It has been left running continuously for days on end with no ill effects.The KTI-20 will drive my Mirage B3016 amplifier, but won't drive both the amp and exciter at once. That's not the supply's fault, since the two together draw almost 27 Amps.

It's a shame that this supply wasn't designed 5 or 10 Amps heavier. The 20-Amp rating is too large and too expensive to drive a low-power 2m rig and too small to drive a solid-state HF rig. But if your total power requirements at 13.8 volts can be met by a 20-Amp supply, the KTI-20 is a good choice at a price that's also a compromise between large and small supplies—$129.99.

For more information, contact *Kem-Tron Industries, 1424 E. Indianola Ave., Youngstown OH 44502*. Reader Service number 479.

John Ackermann AG9V
Green Bay WI

CR2A ANTENNA FROM COM-RAD INDUSTRIES

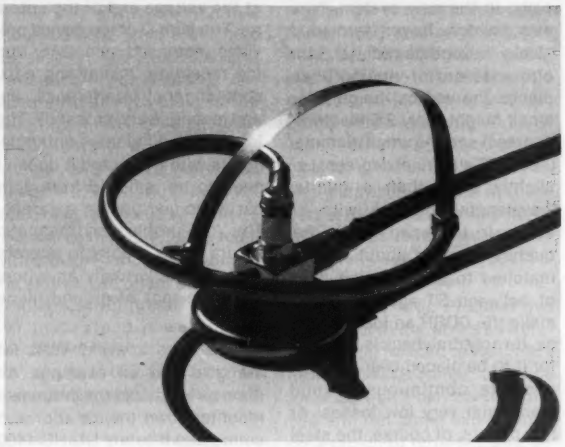
Your first impression will be "What is it?" The second may be "How does it work?" or "Hey, that's sure different—I wonder what it's for?" My neighbors thought I had left a fancy dish on the top of the car, and my wife remarked that it looked like a flying saucer (whatever *they* look like).

To me, it looks like a directional discontinuity ring radiator, or DDRR. . . which is exactly what it is. Okay, I guess I do owe you an explanation about the mystery, so let's take first things first.

A few months ago Jim Waldron of Com-Rad Industries (which means Compact Radiating) called me on the telephone and asked me a few questions about advertising. It seems that Jim has been playing around with antennas for years and has been particularly interested in space-saving antennas, aerials that will permit hams to operate from apartments, condominiums, mobile homes, offices, and the like.

This is all well and good when we are talking two meters and higher frequencies, but what about the HF bands? Aye, that's the rub. . . what *about* them? How can you operate from an apartment or condo when the landlord or the management (or your neighbors for that matter) objects to any outside antennas. What do you do if you're a DXer and an avid rag-chewer, let's say on 20 and 80 meters, respectively.

Well, Jim had thought a lot about these problems and, being a man who has done extensive travelling and his share of operating from the car, from motel rooms, and from other sites, knew about the problems. The one thing he didn't do was give up; he researched various shapes and arrangements of radiators in a variety of combinations and finally developed a combination of radiator, inductor, and capacitance that would allow him to operate on any band from ten through 80 meters with good results. Checking into the several nets he uses, he asked for reports on his signal. He asked DX stations how they copied him, and he rag-chewed with many hams all over the country. . . all on the space-saving designs he developed. They were successful, and he knew that others would like them or more likely *need* them.



Com-Rad's DDRR antenna.

The question he asked me was "How do I get the message across?" and my answer was advertise first in a New Products release, and second in a display ad. So we introduced the first and smallest of the Com-Rad antennas in our May, 1982, New Products section. . . the DDRR model CR2A.

In his travels, Jim had discovered that two meters is almost indispensable for mobile communications. However, there are problems associated with whip antennas in general, and we have all faced these from time to time in varying degrees of severity. Example: I nearly had the entire whip, mount, and coax removed from my car when I drove into the parking garage at Logan International Airport in Boston. . . a high-profile antenna in a low-profile environment. Another case: Using a 5/8-wave magmount antenna for two-meter FM, I lost the whole shebang when it blew off the car at speed (yes, it *was* a bit over 55). Once again, I had become used to the flutter, the QSB, the pruning to length, the removal of the whip before driving into my own garage. . . all nuisances for those of us who operate mobile.

The answer to all this came to Jim in a flash—use a rugged, low-profile antenna of solid construction. Enter the DDRR.

The CR2A antenna has a considerable height reduction over that of full-sized verticals. This lowers wind resistance and completely eliminates mobile flutter (picket fencing). The extremely low angle of radiation enables the directional discontinuity ring radiator to compare, most favorably, with most full-size units. The feed system connects the antenna directly to ground, which provides an automatic static drain from charges induced by fog, dust, and precipitation, affording an improved signal-to-noise ratio.

The DDRR has been around a long time. It was developed for use in hostile environments and in instances where lots of abuse could be expected but had to be withstood. One of the first articles about the DDRR, or "Hula Hoop" antenna as it has been called, was by J. M. Boyer in *Electronics*, January 11, 1963. He suggested that an antenna only two feet high could perform nearly as well as a 60-foot-high vertical antenna.

The problem had always been that when the vertical antenna height is reduced physically and resonance is achieved by loading with lumped reactance elements, efficiency drops drasti-

cally. In the new system, however, which Boyer termed a "leaky waveguide radiator," the circumferential aperture replaces the vertical height. The small height (only 2.5 electrical degrees) and the small diameter (about 28 electrical degrees; i.e., slightly more than a quarter wavelength) together with its ability to be tuned over a frequency range of about 2:1 and matched to transmission lines of between 36 and 500 Ohms make the DDRR an ideal antenna. Its only drawback is the need for it to be placed over the best possible continuous ground plane with very low losses. At two meters, of course, the steel automobile body serves admirably, but copper or aluminum would be even better.

Early models of the DDRR performed within a few dB of their full-size quarter-wave vertical counterparts at frequencies of between 2 and 4 MHz. However, as the frequency increased, so did the apparent efficiency (possibly because of the increased conductor diameter as a ratio to wavelength), and at 30 MHz, the DDRR was shown to be *superior* to a quarter-wave vertical antenna mounted to the same ground plane!

Two hams who have done extensive work with these antennas are W4MIP and W6UYH... and now Jim Waldron W1HGZ.

The Com-Rad antenna is formed of 3/8"-diameter stainless-steel tubing and is bolted to a chrome-plated roof-top magnetic mount. Stainless-steel hardware connects the single insulated wire from the mount to the ring, and a wide copper strap (actually phosphor-bronze strap about 3/8" wide and .010" thick) is connected between one end of the ring and a point on the circumference. The wire and the strap are adjusted to provide the lowest possible reflected power. A coaxial UHF-type chassis connector on the chromed magnetic mount is used to attach your 50-Ohm coax to the antenna, permitting it to lie flat against the car roof.

The tuning ring enables the band-center to be placed anywhere within the two-meter band and beyond, making the device useful outside of the amateur band. The tuning ring replaces the variable capacitor used with conventional DDRR designs and broadbands the system by making a large loop at the voltage end of the antenna. The high-Q of the device provides increased selectivity during reception, minimizing adjacent channel interference, image response and crosstalk. The low profile eliminates entanglements with trees, and it doesn't need to be removed from your car when you park in a garage. The low profile and magnetic mount make it easy to operate the antenna virtually anywhere a square foot of ground plane exists.

How does it work? Well, let me give you an example. As soon as I received the antenna, I mounted it on the car roof and connected it to my NDIHC-1400 two-meter synthesized transceiver by means of a piece of RG-8/U. First, I should explain that the terrain here in New Hampshire is extremely hilly. Repeaters are on hilltops here, as everywhere, but there is an awful lot of rugged terrain in between, and many shadow areas. Consequently, many of us use beams to hit the repeaters from our homes, and (at the very least) 5/8-wave whips on our cars. With a good 5/8-wave whip, and the car parked in the driveway, I can usually bring up about four or five New England repeaters, including the Derry machine, the Mt. Greylock machine, and several others. With my quarter-wave whip, things are a bit tougher. I usually have to go to the top of the mountain to bring up the machines... all except for our local repeater in town.

Thus it was with considerable interest that I put the silly-looking (but tough and rugged and low-profile) Com-Rad DDRR on the car. What the heck, I couldn't do *worse* than the whip... or *could* I? So, I scanned the band... and wait a minute! I'm hearing many repeaters. One after another, I listened, called, and "made the machine." I got good reports (full quieting) and scratchy reports, but I got out—eight times... Eight different repeaters!

The crowning achievement was making the Topsfield, Massachusetts, repeater—about 70 miles distant and on the *other* side of the mountain behind which my QTH lies. Okay, I'm not going to tell you that the Com-Rad DDRR antenna has to be for *you*. All I can say is that it's going to be *my* antenna for two-meter FM mobile from now on. It's strong, it's easy to tune (covers a range from 143-150 MHz and matches 50-Ohm coax at near unity swr), it has a low profile, it's small (not much larger than a saucer), it works like a bandit, it can be removed or replaced in seconds, and it has *no* mobile flutter. Besides all that, it's, well... er, ah... *gotta* say it... kinda cute, and a sure conversation starter wherever you go.

The price of the CR2A is $39.95 (plus $2 postage) delivered to your door, mag mount included, pretuned to about 146 MHz and matched to 52-Ohm coax. For more information about this and other space-saving antennas, write Jim Waldon at *Com-Rad Industries, 1635 West River Parkway, Grand Island NY 14072*. Reader Service number 477.

Jim Gray W1XU
***73 Magazine* Staff**

ROGO CW SOFTWARE

Over a year ago I read an advertisement in *73* for a Rogo Computer Products program that could run CW on a TRS-80. I was a little skeptical, but at the price offered ($19.95), I wouldn't lose too much if it turned out to be a lemon. I had previously tried several other products that didn't work too well on the Model I.

Response time was very fast; I had the product back in less than a week. I received a tape with the program on one side and a message in Morse code at 30 wpm on side B. The documentation was a ten-page leaflet.

The program has two parts, a machine-language loader and the Basic program. Once the tape is loaded, you type RUN and the machine-language driver is POKED into memory. The program then deletes those lines of the program and returns with a second prompt. You type RUN again and you are now in transmit mode. The program will ask you for CALL, RST, & WPM. You can now access the receive mode by pressing the "*" key and answering the prompt with the estimated receive speed. You can now run your demonstration tape.

Interfacing is really simple and adequate instructions are given. Rogo recommends that you key the transmitter with a keying transistor actuated by the audio out of the cassette port. I key my FT-902DM transceiver this way. You can also key your rig with the TRS-80 internal relay or with an external relay. Again, adequate schematics and information on program changes are given.

The program works almost flawlessly on receive. I have compared it with several other products and I have to say Rogo's works best. I have copied CW at over 100 wpm without any problems. Audio is fed into the audio-in cassette port. They recommend that you adjust your receiver so that the note is about 2200 Hz. The received CW also is stored in memory if you protect memory on initialization. On the upper right corner of the screen, if a character is being stored, it will display the character as it is being put to memory. There is a command that can later recall the stored CW and print it in the screen, output it to a line printer, or resend it as CW. You can clear your buffer at any time. The receive program also prints out on the line printer simultaneously as it is receiving. The program outputs to my Microline-80 printer one line at a time during receive. The program does not look for a busy signal from the printer, so there are no program hang-ups and you do not have to worry if the printer is on or not. I have used the program to copy W1AW bulletins and later print them out. It seems to be very tolerant as to sloppy fists and to speed tolerances. If your speed selected is incorrect, simply hit the ENTER key, the program will tell you the actual speed of the received signal, and you can then enter a new speed.

The transmit program can be sent from either the keyboard or from a selection of messages you can permanently put into your program. All customizing instructions are very complete. You can insert the other station's call and RST on initialization of the beginning of each time you go to the transmit mode and then send it out with one key command. There is a CQ command that sends out CQs, pauses for about 10 seconds, and then calls CQ again until the keyboard is interrupted. The only problem with the transmit program is that you can only type ahead one character. I have used a FIFO utility to create a buffer with limited success.

The program comes in 16K or 32K and can operate on a Model

I or III. The instructions tell how to convert the 32K program to disk. All in all, it is well worth the money.

For more information, contact *Rogo Computer Products, 4752 DeBeers Dr., El Paso TX 79924.* Reader Service number 478.

Charlie Milhans KC0CE
Fort Devens MA

PALOMAR SWR AND POWER METER

No matter how you look at it, Palomar Engineering's model M-827 swr and power meter is a unique product and the result of a unique idea... so much so, in fact, that a patent has been applied for.

What can be so different about an swr and power meter, you say? Well, the display, for one thing... LEDs that show both swr and output power simultaneously. These are arranged in two side-by-side vertical columns on the front panel of the meter and light up when rf power (and ac power, too, I must say) is applied. The swr value appears in the left-hand vertical column. The swr scale is logarithmic and is graduated in increments that read from a value of 1:1 up to a value of 10:1, while the output power scale depends upon which range switch can accommodate powers from 0-20 Watts, 0-200 Watts, or 0-2000 Watts, at any frequency between 1 and 30 MHz.

The M-827 is fully automatic, which means that you don't have to set either a *set* or *sensitivity* control when measuring either swr or output power. All you have to do is plug the unit into the house mains (115 volts ac), attach your antenna and transmitter coax, and set the range switch to the peak output power anticipated: 20, 200, or 2000 Watts. A built-in computer automatically sets the full-scale range so that your reading will always be correct. The light-bar, or segmented LED display, is instantaneous, following voice peaks on SSB or keyed characters on CW... meaning that there is no meter lag and permitting continuous monitoring of the essential facts of your transmissions: Are you putting out power, how much, and is your antenna operating normally?

The logarithmic display of swr is useful because at the very low range of swr, the adjustment or tuning of an antenna tuner can be critical, and it is difficult to get those tiny and exact adjustments to ensure a perfect match every time.

For example, I can adjust one of my antennas to read down to as low as 1.02:1 swr. The analog computer and digital comparator in the circuit show exact relationships between output power and swr, meaning that you know at all times just where you are in the antenna and transmitter department. Besides all that, it is plain fun to watch the little red columns fill up or empty as conditions change, and what's more, you can do it in the dark! Maybe I'm one of the few hams who like to operate in the dark, or at least with reduced ambient lighting in the station, but under these conditions conventional metered swr meters and power meters are almost impossible to read. Not so the M-827, which can be seen under virtually all conditions of ambient light from brilliant sunlight to darkness.

The M-827 makes a very nice station accessory, in addition to being useful, because it is also small and attractive. The dimensions of the metel case are 4" x 4" x 5". The top and sides are finished in black vinyl, while the front panel is a neat and conservative brushed aluminum. A power cord for 115-volt, 50/60-Hz ac is furnished (supply built in) and two SO-239 chassis connectors are provided on the back panel, one for input from the transmitter and the other for output to the antenna or to the tuner.

Having owned and used many different types of reflected power meters, I was most anxious to try this new one and to see if it would be compatible with my station and my operating needs. It turned out to be both. I used it to tune and calibrate my new R-3 antenna (report elsewhere this issue) and to measure output power and swr on my other antennas... all of which turned out (thankfully) to have less than 1.5:1 swr. I was also surprised to learn that the output of a popular-brand transceiver that I use is considerably less than what I have been telling hams on the air.

Since the little Palomar swr and power meter works so well, I am looking forward to Palomar's new 300-Watt-range antenna tuner so that I can connect the two and run some experiments on a bunch of different wire antennas that I've had in mind for some time.

Need I mention that due to its small size the M-827 would be an ideal portable companion to take along with your rig to that vacation QTH? That's where mine is going, if I can ever get the time to take a few days off to do some laid-back hamming.

Finally, you don't have to believe everything I say about this little gem from Palomar Engineering. Get one yourself and find out that I wasn't kidding... it's *great*, and I recommend it highly.

For more information, contact *Palomar Engineering, 1924-F W. Mission Rd., Escondido CA 92025.*

Jim Gray W1XU
***73 Magazine* Staff**

LETTERS

ION CHOICE

As a government employee, and therefore one who is often concerned with maintaining a proper office enviroment, I was intrigued by the July, 1982 construction article on the negative-ion generator. I promptly built one, installing it in a decorative plastic vase (complete with decorative plastic flowers) in my decorative plastic office. It seemed to work, improving the atmosphere around the "salt mine." But all this improved atmosphere seemed to be at odds with the usual need for office dissention, so I modified the design by adding a second generator, wired to generate *positive* ions, with a concealed switch to select between the two. Now, I can have my choice of office environment to match my mood; sweetness and light or hate and discontent, all at the throw of a switch. Technology marches on!

T. Bills KG6JFX/5
NSTL Station MS

"ADMIRAL RICKOVER"

At age 56, I must admit that I sided with the old ham fraternity that the code requirement be kept intact. However, as time goes on I am beginning to see your point of view. Please keep up your aggressive stand to reduce the code requirement as a barrier, and to subsitute a more comprehensive and tougher theory exam. We do need younger folks entering the ham radio field... keen minds that enjoy experimenting and developing. I am afraid this energy is being drained off by interest in computers and video fun and games.

In talking with a ham dealer the other day, I sensed that our lackluster sales of ham equipment is not just the economy, but a need for a spark in the radio field. Two meters gave us that newness some years back and now this interest is fully developed and has hit its plateau. Relaxing the code requirement could bring about this second wave and burst of interest we all need. The ARRL should sense this, looking at the long-range picture, and join forces with you. Only the ARRL can bring about a change of mind in the ranks.

I recall my own interest in electronics, radio, and radar in World War II in the Air Force. All my instructors were hams and my personal interest and knowledge of the subject was the result of a next door ham operator who taught me the fundamentals.

I saw USA military helping to train British radio operators and technicians in World War II because our young folks were more knowledgeable. We need this trained back-up civilian group for the future.

You may well be our "prophet" or our "Admiral Rickover" with a better long-range view than most of us. Unfortunately, many see you as a so-called competitor of *QST* (ARRL) and

your views get clouded because of that situation.

Keep up your stand. You have at least convinced me that your ideas are sound.

Ervin Jackson, Jr. N4BIG
Charlotte NC

73 AUTHORS

In this day and time when everyone is writing to you, chewing you out for one thing or another, and complaining about this and that, I thought I would write you a "happy letter."

I have been a continuous subscriber to *73 Magazine* since 1968 and a charter subscriber to *80 Microcomputing* since the beginning. Your viewpoints, due to your first-hand experience and your age, I have totally agreed with, ever since your days at *CQ*.

Wayne, I don't know what it takes to gather a staff and to put out a magazine, but I'm going to tell you about one person's experience—a person with very limited knowledge and many questions to ask about everything. I have built many, many projects out of the pages of *73*. I have built and tried to understand many things out of *80*. In both cases I must admit that I couldn't have accomplished anything without the kind help of the authors of the articles. I don't know where you get these people, Wayne, but there is not a more dedicated group of people anywhere on this Earth. I don't give a tinker's damn whether I make a mistake on a program or there is a misprint in an article—I always know I can write the author and get help, and so far, over the years, with 100 percent response. Now how do you like them apples?

In years gone by, I have started several expensive projects from the pages of some of the other magazines and when I ran into a problem, I wrote the author. After all, his address is printed along with his name. I got absolutely no response, and this was after letters, telegrams, and phone calls. I even had one *QST* (well-known) author tell me to "go to hell you stupid bastard" when I was paying for the phone call and only wanted a simple question answered. Not so with *73* and *80*. I get only very quick responses, and over the years, have gained new and valuable friends who, after months have gone by, take the time out of their own busy schedules just to drop me a line and find out how I'm doing with their particular program or circuit. Hell, Wayne, what more can a person ask?

The world is in one hell of a mess, and everyone knows it. But there are a lot of dedicated human beings out there, like yourself, who feel a little sorry for the other guy and can take the time to give a helping hand to someone who might not be as well educated as they are or not have the experience that they have. Can you believe all this for the simple outlay of twenty cents and an envelope? Well, I can.

I don't want to take up your time, Wayne, because I know you are busy. I simply wanted to let you know that there are a lot of people out here who appreciate all that you are fighting for, as well as what you stand for, but who may not have the time to write and let you know. If you want to publish this, I would appreciate your not using my name. I don't wish to cause any embarrassment to anyone. Keep up the good work, pal.

Name and
Address Submitted

First nice letter in months and he wants his name withheld for fear of repercussions. Boy, what a fan club I've got!—Wayne.

SURVIVING

After reading the letters "No Nukes I" and "No Nukes II" (*73*, July, 1982), I felt that I ought to add my two cents worth.

The letter writers object to "Surviving the Unthinkable," an article which appeared in the May, 1982, issue of *73*, which suggests EMP-hardening of amateur installations. The writers seem to feel that it is possible to avert a calamity by remaining unprepared. By that reasoning, to prevent fires we should get rid of fire extinguishers and fire departments; to prevent burglaries we should avoid using locks.

The assumption that there would be no survivors after a nuclear detonation must never be used as a starting point for deciding what to do. If you are on a sinking ship, the only constructive strategy is to assume that you *will* survive and to act accordingly. If you go down after all, well that's the way it is. But if you *assume* there is no hope, and you don't do anything to help yourself, then you will go down for sure (and you deserve it).

To be unprepared is to invite trouble. As an example, review the events leading to World War II, especially those of 1939 and 1941. If you are unable to stop them, someone will take advantage of you; examples are the "woodpecker," also broadcasts (sporadically) on 10.000 MHz (jammimg WWV time and frequency-standard transmissions), the Falklands episode, Afghanistan, and others. Someone once said, "Those who don't learn from history are doomed to repeat it."

So, let's pray that a nuclear conflict will never happen. But for heaven's sake, let's not announce to the world that we intend to be unprepared, and that we will give in to anyone who threatens us. If we do, you can bet your bottom dollar someone will.

Hans Schroeder AE9G
Milwaukee WI

10 WPM

I think you fail to recognize the one major advantage of CW. It is the only mode which can be sent and/or received by any combination of equipment, from the most primitive (keyed oscillator/superregen receiver) to the most sophisticated (computer-controlled keyboard and printer). Try copying even the slowest Murray from a pair of cans, or sending ASCII with a straight key, and you will begin to appreciate the universality of CW. What I believe is really needed is a reduction in the code-speed requirement for General and Advanced to 10 wpm. This, besides complying with the International Agreements, eliminates that plateau which discourages so many would-be hams. Anyone who further pursues CW will automatically increase his/her speed, and the others lose their edge anyway so there really is no loss.

As for the Bash books, any good teacher can tell you that there are many ways to reword the same question so that a memorized answer will not suffice. The FCC could easily have a hundred versions of the same exam if they desired. Then these "guides" would be nothing more, just guides. By the way, in case you've been out of college too long, study guides are very useful in that they reduce the nervousness before an exam by proving to you that you *do* know your subject.

George Gray WB2CHP
Spring Valley NY

By George! You're right. All we have to do is get after Reagan and get him to increase the money to the FCC so they can write more tests and frustrate Bash bookers. The recent cuts in FCC funds brought about a severe cut in the amateur radio division... and more cuts are in prospect. Let's get Reagan busy on getting some of the missile money into the ham division of the FCC so we can have better tests. On the code, since polls show that most hams want the code test to stay, let's make the code so it really is the filter everyone wants and will keep out the fruits and nuts. Let's make the Novice code test 35 wpm and the General 45 wpm. Advanced could be moved to 55 wpm and Extra to 75 wpm. Or we could simplify the whole thing by splitting it in the middle and having one speed for all further licenses: 50 wpm. We can cut down on Bash's income by having just one class of license... Extra. That would cut the cost to the FCC, with only one license test to give, and they could spend more time making it difficult.—Wayne.

COMPROMISE

As to the no-code license, there seem to be two schools of thought on the idea, with neither side willing to give an inch. I feel that the "Let's-keep-the-code group" is broken down into two subgroups. One subgroup feels it would ruin amateur radio and the other has the attitude..."I got mine the hard way, let everyone else do the same." I disagree with both subgroups. But, that's not to say either group is entirely wrong.

Why not a compromise? Why not a six- or seven-wpm code test? Who says that thirteen wpm is the magic speed that makes you a licensed amateur and a good ham radio operator? How many operators pass their General test only to put the key away for good? How many Generals could pass a thirteen-wpm test right this moment? Isn't

theory, good operating procedures, and knowledge of all the rules and regulations more important than being able to copy thirteen wpm?

Of course there are a lot of darned good CW operators on the bands and the thought must come to mind that if CW was not a requirement, what would happen to the CW portions of the bands? That is one of the reasons why we should compromise and keep some CW requirements.

I would like to ask the "I-got-mine-the-hard-way subgroup" if they still add and subtract by hand as they were taught in grammar school.

To the subgroup that feels that it would ruin amateur radio, let me say I see no reason why knowledge of more than six-wpm CW would be of any value to operating in the RTTY, SSTV, AM, SSB, ATV, or FM modes. If you feel that the same people who ruined CB would then move up to ham radio and ruin it, I could not disagree more. First of all, most of these people don't even hold CB licenses, so why would they bother to get an amateur license? Why don't they just move to our bands and operate in the same illegal manner as they are accustomed to in their own bands? What is to stop them? A thirteen-wpm code test? I can't buy that.

As to the no-coders (to which I belong), let's face reality, it just isn't going to happen on the HF bands. So why not compromise?

Wayne, as I indicated to you earlier by a copy of my letter to the FCC, I feel that the Technician class should be able to operate in a voice portion of the 10-meter band. I would like to hear comments on that idea as well.

Joseph D. Kelly N2CCV
Wildwood NJ

Joe, we're sure beating this code thing to death with blather. But never mind, I'm still able to limp to my typewriter and write about it. Firstly, six words per minute? Horsefeathers! Apparently you are unaware that the 13-wpm speed was picked with fiendish delight by our long dead torturers. That speed was not picked at random. You see, though we are just in recent years learning how the brain works, the empirical tests showed us that there was a plateau at around ten words per minute. The old-timers didn't know why this was, but they did know that, using the code-learning techniques of 1910, this was a formidable obstacle to learning the code at any reasonable speed. So naturally they set the speed required for a ham ticket just above this plateau. Before they pulled this beaut the code speed for a ham ticket was 10 wpm and few people had much trouble with that. The 13 wpm weeded out 90% of those trying for the license... a much more satisfactory situation for the old-timers interested in keeping the bands from getting too crowded.

We now know that the old-fashioned code-learning system called for one side of the brain to set up a look-up table (to use computer terms). The other side of the brain received the signal, sent it over to the other hemisphere where it was checked against the table, and the resulting letter found, this message was sent back so it could be written down. The problem came when the speed of transmission of the brain was reached... at around ten words per minute. Beyond that the brain could not look up the characters fast enough and frustrations set in which usually resulted in the candidate giving up.

The brain had to respond by giving up that whole method of translation of the sound patterns and throwing away both the look-up table and the oscillation of the information back and forth between the two halves of the brain.

Now we know that what happened was that the brain set up a whole new system whereby the sound patterns were equated to the writing of the letter or the typing of the letter, without the problem ever having to be referred to the other part of the brain. This is done on a subconscious level and is quite automatic. This is why good code ops are able to sit and talk with you while copying code. They don't have to listen on a conscious basis at all.

Now, in order to get code learned using this system of brain work, it is necessary to develop the automatic process. Modern code-teaching systems start out with code at 13 wpm, which keeps the look-up table syndrome out of the picture. They space the sounds to give the brain time to set up the translation patterns... not to tell you what the characters are one by one, but to cause your fingers to write them. The brain adapts to the sound patterns quickly with this approach.

Obviously, if you are going to go up to 20 wpm for the Extra-class license, you don't want to gradually speed up the code, you want to change immediately to 20 wpm and retrain the subconscious to recognize the new sound patterns... and write the letters. This is why people using this system of learning are able, in many cases, to start right in at 20 wpm and, within a couple of days, be copying away.

You know, I've tried to get the League to stop using the 1910 code-teaching system for almost 20 years. I eventually gave up and put out my own code tapes. Suddenly, thousands of people who had virtually given up on ever passing the code test found out that it was duck soup. I'll bet I've had over ten thousand hams tell me that my code tapes got 'em through... often after repeated failures with other systems.

Okay, so much for that. My apologies to readers who have been through that story before, but for some reason it always seems to be news to some.

The enthusiasm of many hams for CW and their insistence on all newcomers having to pass a code test as a way to ensure that they will enjoy code is, at best, faulty psychology. People don't work that way. Hells bells, I enjoy RTTY, but I know that if I try to force people to learn about it they are going to react the way any rational person does: they are going to resent being forced. No, if we made CW use a matter of pride rather than something our government forces us to do, I know that we would have a lot of CW enthusiasts.

The people of Russia and China may have gotten used to slavery, but we here in America haven't. Look at the resistance to the draft... which qualifies, I think, as slavery. It looks to me as if the CW fans have been doing the one thing which has most resulted in what they don't want: forcing people to learn the code resulting in antipathy to it.

Techs on ten meters? Sure, as soon as you get rid of the code as an element required for the General license.—Wayne.

SILVER PLATTERS

For the past six months I have been reading a lot of letters from readers concerning the no-code licensing. Our country is already burdened with give-away programs such as welfare. Now we have advocates of give-away amateur radio licenses.

I don't work a lot of CW, but I am one of the few people in this country who believes you don't get something for nothing. Do you get a medical or law degree, or even a high school diploma without having to learn some things that you may never use? No you don't, but as with the no-code licensing advocates there are probably those who would like give-away high school and college degrees. The problem is that too many people want to do away with requirements that keep them from taking the short cut.

The requirement for learning the electronic theory has already been done away with by Bash Publications, and now there are those who want to do away with the code test. As it now stands the only thing that keeps many from getting their amateur licenses is that they are too lazy to learn the code. Why don't we do away with the Dick Bash cheat sheets and keep the code test?

If the rules are not followed prior to getting on the air then what will happen after these people get their tickets? I suspect that these same individuals will break the rules and cut the corners after they have gotten on the air as they did prior to getting on the air. This is already occurring on the 2m bands in some of our larger cities.

In conclusion, I would like to say that if you don't want to work for what you want, then get your checkbook out and go to your local department store and buy a CB. All you need to do is fill out the form that is enclosed with the CB, send it to the FCC, and you are on the air. You will be right at home with the rest of your kind. I am not saying that all CBers feel that way, but I started out on the CB band and I knew what I wanted so I worked for my license. You can't get through life expecting everything to be given to you on a silver platter just because you don't want to pay the price. Let's all hope that amateur radio li-

censes are not handed to the same individuals on silver platters.

Jerry Leckness KD4XR
Tuscaloosa AL

Jerry, you either don't read carefully or else you have poor retention. You also have one hell of a negative attitude, for you had not one single positive suggestion about solving the problem of getting good hams. And I can't take your beef about the Bash books seriously until I see a copy of a letter from you asking CQ not to run his ads... or a letter to a ham dealer saying you're not going to buy from him as long as he sells those books. I have yet to hear of one single case where any ham has gone into a dealer and torn up the Bash books on display... not one. No, 100% of the hams have accepted this flagrant poisoning of our hobby. Not one single ham club in the country has taken a stand against Bash, so I must assume that 100% of the hams don't give a damn whether or not any newcomers have any technical knowledge... and that includes you, Jerry. Ham licenses are being handed out on silver platters and I don't see you doing anything but griping. The code doesn't prove anything. Some people can learn 20 wpm in a weekend, others can struggle for months and not get 5 wpm... that's a matter of chance and genes.—Wayne.

DIGITAL CODE

The FCC is doing ham radio amateurs a great injustice by not replacing the Morse code with a more viable alternative and by being reluctant to introduce computer technology into ham radio.

The Morse code, being a good base for communications, is at present outdated and not in step with our current technology. It remains for many a nostalgic foothold with the past—a good feeling of taking part in something that originated in past history. However, Morse code does not a true amateur make! There are many good hams around that had (and still have) the darnedest time learning the code to get their licenses. And then there are many code experts who are not good hams at all. There are also good hams who are good at code. A true ham radio amateur is one who has the proper spirit, attitude, and dedication to radio communications, no matter what the method used to communicate or the kind of ham gear used. There are many would-be amateurs who have the proper attitude but have a hard time getting their ticket because they cannot feel the rhythm of Morse code. This is akin to the person who either likes or dislikes classical, jazz, pop, or folk music. In many cases it means you either have it or you don't. This is very unfair to a true radio amateur.

As an alternative to Morse code, I would propose the FCC adopt a digital code. An exam would be given in two parts. In part A, the applicant would have to prove mechanical and proper operation of a basic keyboard encoder-decoder. In part B, the applicant would be given a test on digital-code theory to show understanding of what makes it work. This is not difficult and has its roots in Morse code basics—an on-off switch. As for buying the equipment, there are many economical systems now available, and by the time the FCC adopts such a resolution, prices would drop further.

As for computers and ham radio, it is the only way to go. It is not true that the human touch would be gone with computers, as many feel. Once again this is a vestige from the past. In contrast, the computer can allow the ham more room for human expression. An alphanumeric keyboard has limitless possibilities for personal touch communications. Those who criticize the computer don't understand its operation, don't own one, or don't know anyone who owns one and knows what it's all about. After all, a computer is nothing more than an off-on switch, the number of switches related to its capacity or memory, and the switching done electronically. In fact, a Morse-code keyer is a basic computer. So hams have been using computers for years, but they don't know it.

Roger E. Berube
Nashua NH

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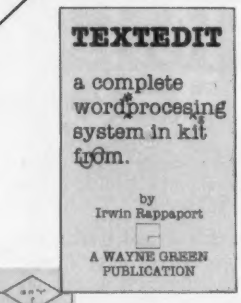

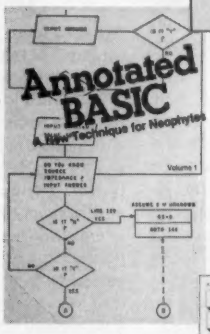

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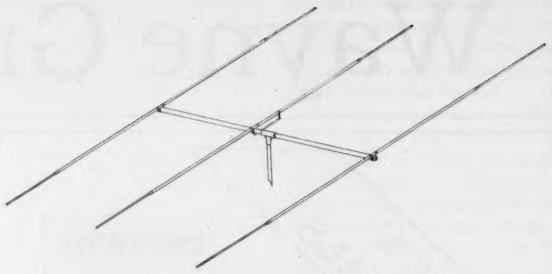

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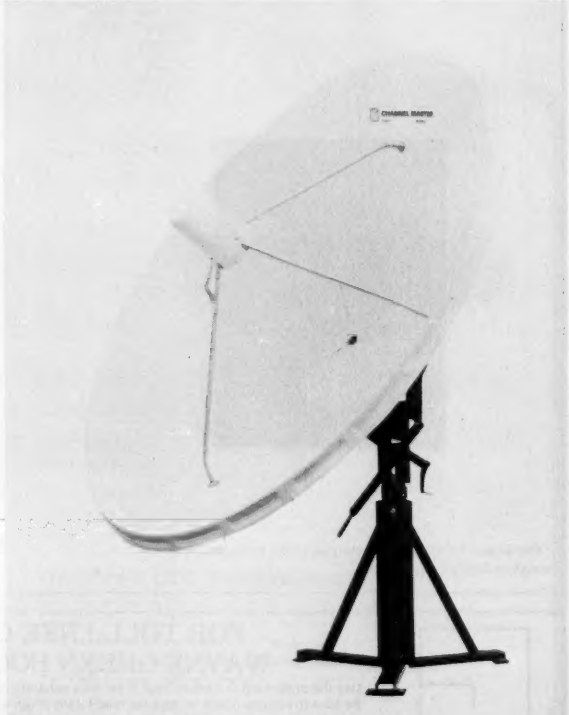

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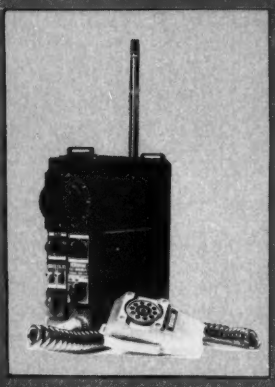

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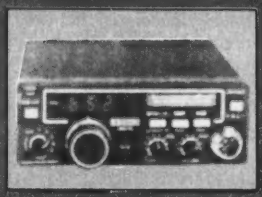

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Orbit

ORBIT is the Official Journal for the Radio Amateur Satellite Corporation (AMSAT), P.O. Box 27, Washington, DC 20047. Please write for application.

For a **FREE SAMPLE COPY** please send $1 to cover First Class Postage and handling to: Orbit, 221 Long Swamp Road, Wolcott, CT 06716.

See List of Advertisers on page 130

duced spillover for minimum interference and noise pickup and gives .5-dB-gain improvement over conventional rectangular feeds. For optimum dish performance and ease of installation, the unit is factory pre-calibrated to the exact focal length from the reflector.

Waveguide-coupled to the LNA, the integral feed polarizer makes possible convenient dual-polarity reception and eliminates the need for complicated feed rotation or expensive double LNAs. The probe automatically assumes the correct position for any channel selected by the receiver, without additional polarity adjustments.

The turnkey system complete with 12-foot dish is $5295; with a 10-foot dish, $4995.

For further information, contact *Channel Master, Division of Avnet, Inc., Ellenville NY 12428; (914)-647-5000.* Reader Service number 483.

KALGLO'S SURGE SUPPRESSORS

Kalglo Electronics Company, Inc., has added a new Quad series to its line of surge suppressors designed to protect sensitive electronic equipment from damaging power-line transients, high-voltage surges, and electrical noise interference conducted along ac lines.

Quad surge suppressors have four filtered outlets, which take care of computers which need more than two filtered outlets (such as the Apple, for example). The Quad-I has transient absorption only, while the Quad-II has transient absorption plus dual 3-stage low-pass filters for RFI "hash" filtering.

All units are prewired and ready to use. For more information, contact *Kalglo Electronics Company, Inc., Department Quad, 6584 Ruch Road, East Allen Township, Bethlehem PA 18017.* Reader Service number 486.

THE CES 635 MICRODIALER

Communications Electronics Specialties announces their new CES 635 Microdialer, designed to make life easier for the mobile radio operator. The 635 incorporates the microphone element and the keypad buttons

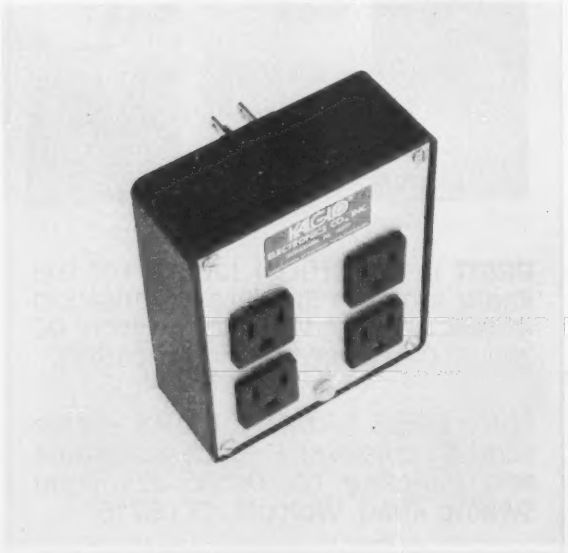
The CES 635 Microdialer.

on the *same side* of the microphone, enabling the mobile operator to put through an autopatch call without ever taking his eyes off the road.

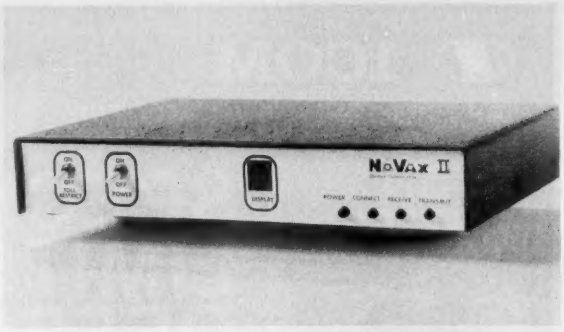
The Microdialer features a programmable pause that allows the operator to bring up the patch, pause, and dial the telephone number by pushing two buttons. It also keys the PTT line prior to sending the first tone so that nothing is lost in the transmission.

The first five memories hold up to eleven digits, and memories six through zero hold up to seven digits. Dialing speeds from one to eight digits per second can be programmed as desired.

The suggested retail price is $99.95. For additional information, contact *Communications Electronics Specialities, Inc., PO Box 507, Winter Park FL 32790.* Reader Service number 485.



Kalglo's plug-in surge suppressor.



Current Development Corporation's Novax II mobile connection.

NOVAX II MOBILE CONNECTION

Current Development Corporation (formerly R.W.D., Inc.) announces its new Novax II Mobile Connection for interfacing with DTMF (TouchTone®) and rotary-dial telephones. In addition to the standard features provided by Novax I, Novax II offers: 4-digit access code, LED display, toll restrict, repeater use, and rotary-dial-interface capability. Both units employ high-speed switching techniques, eliminating voice-activated switching problems.

Suggested retail prices are: the base unit, $279.95; the rotary module, $49.95, and the ringback module, $39.95.

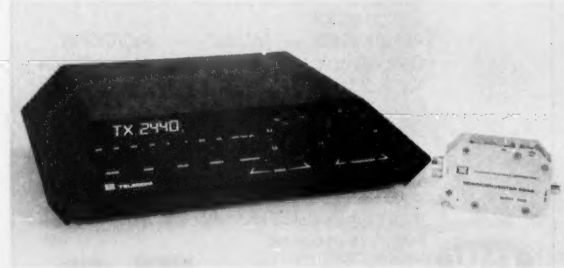
For more information, contact *Current Development Corporation, Box 162, Tudman Road, Westmoreland NY 13490.* Reader Service number 484.

SATELLITE EARTH-STATION RECEIVER SYSTEM

Telecom Industries Corporation has just announced their new TX-2440 satellite Earth-station receiver system. The receiver incorporates several unique features, including a three-position audio-subcarrier bandwidth selector, and an LNA-mounted, dual-conversion downconverter (patent pending) that enables any LNA to be converted to an LNC in seconds. The TX-2440 lists for $895. For additional information, contact *Telecom Industries Corporation, 27 Bonaventure Drive, San Jose CA 95134.* Reader Service number 491.

RIDGE SYSTEMS RTTY INTERFACE

Ridge Systems Co., Inc., has



Telecom Industries' new TX-2440 satellite Earth-station receiver system.

WHY COMPRO-MISE

Others claim more gain for their antennas than the IsoPole™ antennas, but none can beat the IsoPole for HONEST on-the-horizon omni-directional gain unless you are willing to spend at least THREE TIMES AS MUCH!!! The IsoPole is easiest of ALL competitive models to assemble, has a weather protected, factory-tuned matching network, (no more aggravating SWR variations with weather changes), uses all stainless steel hardware, and is designed to withstand severe icing and wind conditions. The IsoPole antenna is UPS shippable without the standard 10 foot 1¼ inch TV mast. You can buy the mast from your local ham dealer, hardware store, or Radio Shack™ store for less than the shipping costs of a single mast. When good strong, low cost 10 foot sections of mast are so easily available, why compromise by using several shorter pieces that have to be joined together?

For more details, please write for our latest catalog or visit your favorite dealer.

Prices and Specifications subject to change without notice or obligation.

ADVANCED ELECTRONIC APPLICATIONS, INC.
P.O. Box C-2160,
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(206) 775-7373
Telex: 152571 AEA INTL

↙2

AEA Brings you the Breakthrough!

DON'T TIME OUT . . . TIME IN *Introducing Toggle Time*

Model TI-10 time alert for repeater operators to avoid timing out repeater. (PATENTED) *Sensitive enough for H.T.S. *Automatic; Sense RF carrier-no connections to rig *Battery powered *Resets on carrier drop-out *Adjustable timing period *Size 5 1/4×3 5/16×1 3/4 *Weight 8 oz./226.8 Grams Piercing, 6.5 KHz alert tone

Toggle Time is a 10 minute timer that would be utilized by a ham to keep within FCC 10 min. ID rules. It is actuated by a toggle switch which serves two purposes:

Model TI-10 assembled..$69
Model TI-10k, kit form..$52
Printed Circuit Board and Documentation.....$15.00

Dealer Inquiries Invited

✶ Begins timing period when power is applied. ✶
When Toggle Time times out it lets you know with a loud tone. Price $14.95
Shipping & Handling add $2 Send check, money order or COD *battery included

↙140 ✶ When ordering, please specify model ✶ 3 1/4×2 1/8×1 1/8

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POWER POCKET™

Gives You Hand-Held to Mobile and Back Again!

Simply plug in your Icom IC-2A (T) and you have a 25-35W synthesized mobile rig — take it out again, all charged and ready, when you want hand-held operation.

RF POWER—the Power Pocket amplifier/charger accepts any version of the IC-2A and applies its output to a wide-band rf amplifier. With 4W input, the Power Pocket delivers 35W output; 3W in brings 30W out, 2W becomes 25W, and the ½W low power position yields 5W output.

AF POWER—the Power Pocket provides 2½W audio output and a 4-inch speaker so that messages can be heard above road noise, even with the windows down. Also, you can operate the IC-2A at low volume, thus less drain on the battery pack.

CHARGING POWER—the spring-loaded charger pocket adapts to tall or short packs; accepts and charges all Icom battery packs. Separate "charge" switch and indicator lets you charge battery pack whether or not the amplifiers are in use. Charge is supplied at 35 mA rate, which *(a) with IC-2A(T) off,* will give a complete charge in 10 to 14 hours; *(b) with IC-2A(T) on and receiving,* supplies all needed radio power, maintaining battery.

EXTRA CHARGING POWER—when the VoCom Power Pocket's mic is keyed, its charger supplies 400 mA to power the IC-2A(T) so that there is little drain on the battery. With the IC-2A(T) turned off, this 400 mA can be used to provide a quick charge for emergency needs.

MIC PREAMP—the adjustable mic preamplifier lets you use the IC-2A(T) in or out without readjusting its mic input. It also makes the Power Pocket compatible with any standard mobile microphone.

Suggested retail price, $229.95 (includes mic). See your favorite amateur radio dealer.

↙90

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PRODUCTS CORPORATION
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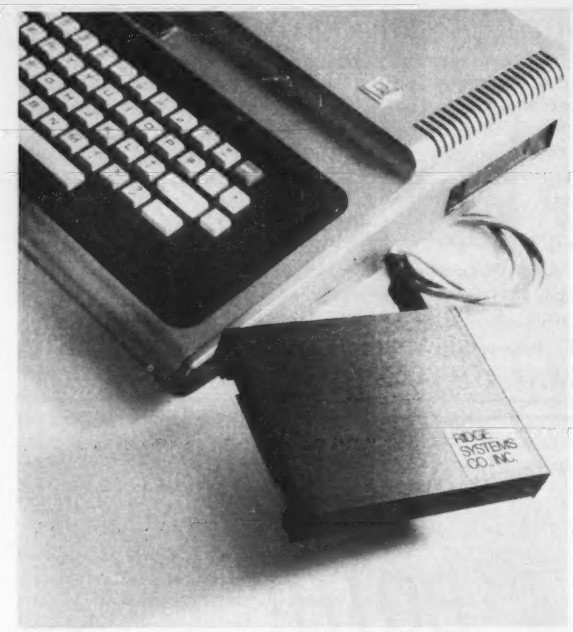
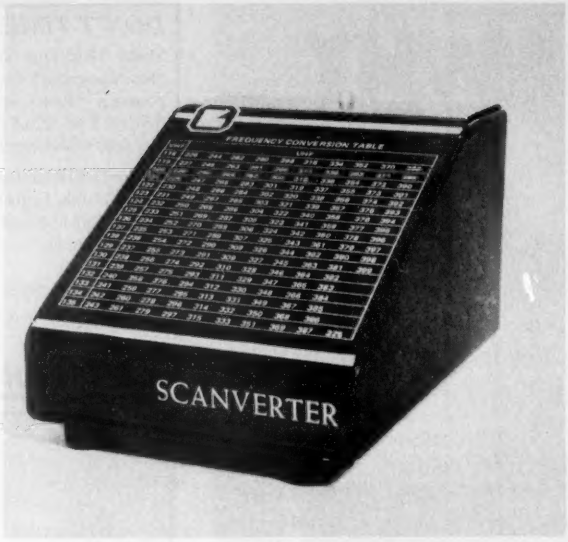


RTTY interface for the TRS-80 color computer, by Ridge Systems.



The Grove Enterprises 225-400-MHz scanner converter.

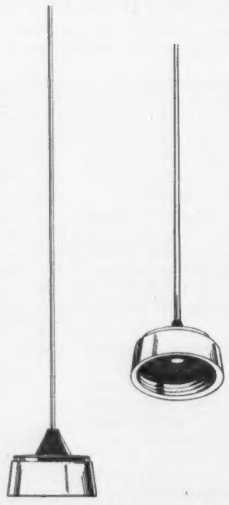
announced the model 4511 RTTY interface for the TRS-80™ color computer. The interface plugs into the Program Pak™ slot and contains all the software and hardware in a ROM cartridge. The five-pin DIN plug on the back of the cartridge provides the EIA signal connections to your terminal unit. Operating features include keyboard control of the message and operating buffers, transmitter on-off, station identification, and 110-baud-ASCII or 60-wpm-baudot mode selection. The split screen simultaneously displays text being entered, messages being received, and system status. Further, the interface firmware supports a printer and selective calling that automatically stores the incoming message on cassette tape.

The interface is designed to be reliable and easy to use. An internal buffer makes operation easier by allowing simultaneous text reception and text entry from the keyboard or permitting one to save incoming text for later re-transmission. The cassette tape permits you to save important or frequently-used messages and reload them as needed. The instruction manual describes installation and use of the interface and contains a schematic diagram, parts locator, maintenance data, and information on selected subroutines. $169.95 includes interface, manual, and 90-day warranty.

For more information, contact *Ridge Systems Co., Inc., PO Box 772, Acton MA 01720; (617)-264-4251.* Reader Service number 489.

MULTIBAND QUARTER-WAVE ANTENNA

Larsen Antennas has introduced the NMOQ special quarter-wave antenna which makes it unnecessary to stock a different antenna for each band.



The Larsen Electronics NMOQ quarter-wave antenna.

The NMOQ adapts one antenna for a full range of frequencies from 136 to 512 MHz. Just cut the rod to the desired frequency.

With a suggested retail price of $7.97, the Larsen NMOQ uses a chrome mounting nut and a silver-plated contact attached to the rod with a set screw. The silver-plated contact has less resistance than the stainless-steel rod and ensures a low resistance rf connection.

Two models are available. Order the complete antenna to fit the NMO mounting hardware, or the NMOQ Special W for the antenna without the chrome mounting nut. For more information, contact *Larsen Antennas, PO Box 1799, 11611 NE 50th Avenue, Vancouver WA 98668.* Reader Service number 488.

THE GROVE ENTERPRISES SCANNER CONVERTER

Grove Enterprises has just announced a new 225-400-MHz scanner converter, the Scanverter CVR-1, which will allow complete coverage of the 225-400-MHz military/federal government aircraft band when used with a standard aircraft band scanner.

Scanverter CRV-1 makes it possible to listen to NASA space-shuttle radio links to Earth, military air tactical war games, Coast Guard search and rescue missions, FLEETSATCOM military satellites, federal government agencies in flight, and more.

A new development called "bandstacking" allows the entire 175-MHz-wide UHF aircraft band to be compressed into the 118-136-MHz range that is tunable on any scanner capable of standard VHF aircraft-band reception. No tuning or adjustments are necessary with the fully-automatic CVR-1.

Standard features of the Scanverter include: a high-sensitivity, low-noise microstripline circuit, an all-metal cabinet for superior shielding, a frequency-conversion chart printed on the cabinet, a double-balanced mixer for reduced images, an eleven-pole filter for suppression of out-of-band interference, a crystal oscillator for high stability, and a zener-diode voltage regulator for limiting drift. A power cord for connection to a 12-volt dc supply (not furnished) and an interconnect cable for connecting the CVR-1 to your aircraft-band scanner are also furnished. Suggested retail price is $99.95.

For more information, write *Grove Enterprises, Brasstown NC 28902.* Reader Service number 487.

TWIN OAKS ASSOCIATES' CW TEACHING SYSTEMS

Twin Oaks Associates is a partnership of mental health professionals who are hams interested in helping others to learn CW. Twin Oaks has developed three Morse code teaching systems on tape which represent the careful application of

psychological principles to learning. They help students learn to recognize and copy Morse characters at a very high speed.

The first set of tapes is called System 12©. It is designed for the ham who may have a Novice or Technician class license but can't "get over the hump" to pass the General class code test. System 12 takes students past 15 words per minute on five carefully-structured, successive-demand, 60-minute cassettes.

The second training program is called System 24©. It assumes that the student is able to copy comfortably at 9 or 10 words per minute but would like to go after the amateur Extra class license. This program is on five 60-minute cassettes and carries the student past 30 words per minute.

The third teaching system, the System 12 Alphabet Book©, is designed for persons who know absolutely nothing about Morse code. It may be used, however, by persons who are not thoroughly comfortable at 5 words per minute, and it is useful for either classroom or self-instruction.

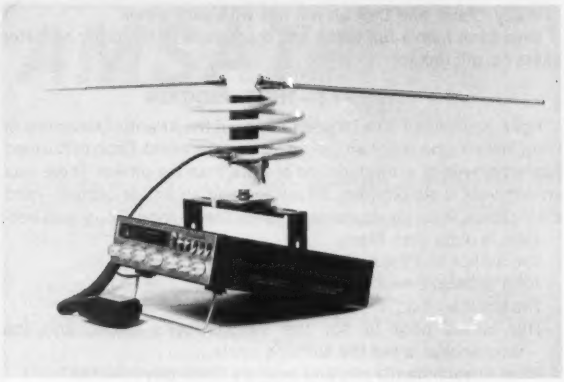
Each program, or system, comes with its own carefully-written study guide. Systems 12 and 24 cost $30 each, and the System 12 Alphabet Book costs $15.

For more information, write *Twin Oaks Associates, Route 5, Box 37, Knoxville IA 50138.* Reader Service number 482.

COM-RAD INDUSTRIES ANTENNAS

Com-Rad Industries has just announced the availability of two new antennas in its line of space-saving antennas for fixed and mobile amateur radio operators.

The CR-1011A and CR-6A cover the amateur 10- and 6-meter bands, respectively. Each antenna is a full-sized quarter-wave vertical groundplane that has been rearranged mechanically to be only 5% of its normal height. It consists of a basic helic element with an adjustable telescoping capacity hat/tuning ring for resonating the antenna to the desired frequency.



A Com-Rad Industries' space-saving antenna.

Each antenna is constructed of stainless-steel hardware, aluminum helix elements, stainless-steel telescoping capacity hat, and corrosion-proof support structure.

The CR-1011A provides a low-vswr match to 50-Ohm coaxial cable over any preselected 400-kHz segment of the 10-meter band, and the CR-6A provides a low-vswr match to 50-ohm coaxial cable over any preselected 700-kHz segment of the 6-meter band.

For price information and further details about these and other antennas, contact *Com-Rad Industries, 1635 West River Parkway, Grand Island NY 14072.* Reader Service number 490.

FUN!

John Edwards KI2U
78-56 86th Street
Glendale NY 11385

LOGIC TIME

You know, time really does fly when you're having FUN! I can hardly believe it, but this month marks the second anniversary of the FUN! column. That's a lot of riddles and puzzles under the bridge, but it's been a gas. If you've had fun solving the quizzlers presented here, just remember that I've had even more fun creating them. So much fun, in fact, that it feels almost dishonest to take the money Wayne offers—but I really don't have much of a conscience.

I hope you'll enjoy this month's offering: some logic puzzles.

ELEMENT 1—MARC'S CONTEST

During a 24-hour contest, Marc can average two contacts per minute from noon to midnight and six contacts per minute from midnight to noon.

How many contacts will Marc average for the entire contest?

ELEMENT 2—THE DX QSO

A QSO on 20 meters the other night found four hams enjoying an international roundtable. All four operators were of different nationalities and although each could speak two of the four languages—English, French, German, and Spanish—there was no common tongue by which they could all communicate. Complicating matters even further, only one of the languages was spoken by more than two of the amateurs.

None of the hams spoke both German and French.

While Vic couldn't speak English, he acted as a translator for Carl and Dave.

Vic, Carl, and Larry didn't all speak the same language.

Dave could speak German, and rag-chewed with Larry, but Larry could not speak German.

Name the pairs of languages each ham spoke.

ELEMENT 3—COFFEE AND DONUTS AND MURDER

Four hams were standing together after a meeting of the Skunkville ARC enjoying the club's complimentary "coffee and donuts." Suddenly, one of the hams collapsed, moaned "I've been poisoned," and died. His fellow amateurs were arrested and made the following statements under intense questioning (one of the statements is false):

Hertz: I didn't poison him.
I was standing next to Farad.
We had the regular man buy the coffee and donuts.

Ohm: We had a new guy buy the coffee and donuts.
I was standing across from Watt.
The guy who bought the coffee and donuts didn't do it.

Farad: Hertz is a liar. We had a new guy buy the coffee and donuts tonight.
This new guy poisoned Watt.
Ohm is innocent.

Name the murderer.

ELEMENT 4—THE FRIENDLY REPEATER

Repeater station WA2DCS/R has some very touchy users. For instance, five members, whose first names are Harvey, Wally, Steve, Dick, and Stan, and whose last names in no particular order are Tracy, Walters, James, Phillips, and Lewis, have had so many arguments over the years that they will talk to each other only under the following conditions:

Walters will speak to only two of the others.

Phillips and Wally won't talk, but Steve and Lewis will.

Stan will speak to all but one. Harvey will speak only to one of the others.

There's only one out of the group that Tracy won't speak to.

There's only one out of the group that James will speak to.

Wally, Steve, and Dick all will talk with each other.

Give each ham's full name and the names of the other repeater users he will talk to.

ELEMENT 5—THE DXPEDITION

Four men set out on a DXpedition to put the Atlantic Ocean Isle of Long in the logbooks of amateurs around the world. Each of the men was employed in a different line of work than the others. There was an engineer, a stockbroker, an author, and an airline captain—and their names, in no particular order, were Steve, John, Doug, and Bob.

John is older than Steve.

The author and the airline pilot are brothers.

John is Doug's nephew.

The engineer had no relatives on the DXpedition.

The airline pilot is not the stockbroker's uncle, and the stockbroker is not the author's uncle.

What is each ham's job, and how are these guys related?

ELEMENT 6—THE TRAFFIC HANDLERS

Four Advanced-class operators and three General-class operators handle as much traffic in five days as three Advanced-class operators and five General-class operators do in four days.

Which class of operators is more productive?

THE ANSWERS

Element 1:
Three contacts per minute.

Element 2:
Vic spoke Spanish and French. Dave spoke Spanish and German. Carl spoke English and French. Larry spoke Spanish and English.

Element 3:
Farad is the killer.

Element 4:
The full names are: Steve Tracy, Wally Walters, Harvey James, Stan Phillips, and Dick Lewis. Tracy will talk to Walters, Phillips, and Lewis. Walters will speak only to Tracy and Lewis. James speaks to Phillips, while Phillips will talk only to Tracy, James, and Lewis. Lewis talks only to Tracy, Walters, and Phillips.

Element 5:
Steve is the engineer. John is a stockbroker. Doug is an author. Bob is the airline pilot. John is Bob's son and Doug's nephew. Bob and Doug are brothers.

Element 6:
The General-class operators.

SCORING

Each element is worth seventeen points. "Logic is logic. That's all I say."—Oliver Wendell Holmes.

1-20 points—Not rational
21-40 points—Semi-rational
41-60 points—With a ration of rationality
61-80 points—Rationalist
81-100+ points—Very smart

CONTESTS

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

CALIFORNIA QSO PARTY

Starts: 1600 GMT October 2
Ends: 2159 GMT October 3

Sponsored by the Northern California Contest Club, with strong efforts being made to have all 58 counties in California on for the contest duration.

Single-operator stations may operate only 24 hours of the contest period; off times must be clearly marked in the log. Multi-operator stations may operate the full 30 hours. Stations may be worked only once per mode per band. All contacts must be simplex. All CW contacts must be made in the CW subband. California stations that change counties are considered to be new stations and may be contacted again for points credit.

EXCHANGE:

California stations send QSO number and county. Others send QSO number and state, province, or ARRL country.

FREQUENCIES:

Novice—3725, 7125, 21125, 28125.

CW—1805, 3560, 7060, 14060, 21060, 28060.

SSB—1815, 3895, 7230, 14280, 21365, 28560.

Try CW on the half hour and 160 meters at 0500.

SCORING:

Each completed phone contact is worth 2 QSO points. Each completed CW contact is worth 3 QSO points. For multiplier, California stations use the number of states, VO/VE 1-7, and VY1/VE8 for a possible of 58. Others, use the number of California counties worked for a possible total of 58. The final score is the number of QSO points multiplied by the total number of multipliers.

AWARDS:

Certificates for highest-scoring station in each California county, each state/province, and each country. Certificates also to each station scoring 100 or more QSOs. Trophies to the highest-scoring out-of-state single operator, highest-scoring California single operator, and highest-scoring DXpedition to a California county.

ENTRIES:

All logs and summary sheets must be sent by November 1st to: NCCC, c/o Kip Edwards W6SZN, 1928 Hillman Ave., Belmont CA 94002. Please include an SASE with your entry.

GARTG WORLDWIDE SSTV CONTEST PART 2

Starts: 0600 GMT October 9
Ends: 0600 GMT October 10

This is the second part of a two-part contest—the first weekend was in April but rules were received too late for publication. The contest is sponsored by the German Amateur Teleprinter Group (GARTG). A 6-hour nonoperating time must be taken at any time during the contest. Use 80- through 10-meter amateur bands, SSTV mode exclusively. The same station can be worked only once per band. Operating categories include: a) SSTV transmitting and receiving stations and b) SSTV receiving stations (SWLs).

EXCHANGE:

Callsign, RST, message number as three-figure group starting with 001, and GARTG membership number as 5-figure group.

SCORING:

Score 1 point for all SSTV contacts on 80 through 20 meters, 2 points on 15 meters, and 5 points on 10 meters. Multipliers are each country of WAE and ARRL lists, including KL7 and KH6. Each W/K, JA, PY, VE/VO, and VK district will be considered as a separate country. The same continents and countries are valid only once on each band. Final score is QSO points times countries worked times continents. To this score add a 50-point bonus for each GARTG member worked.

ENTRIES:

Logs to contain date/time in GMT, callsign of station worked, RST and message number sent, RST and number received, and points claimed. Don't forget to list the GARTG membership numbers as bonus points! Logs from SWLs must contain both the full report sent and received by the station logged. Incomplete loggings are not eligible for scoring. A summary sheet should show the full scoring and please use separate sheets for each band. All logs must be received within 2 months of the contest and should be addressed to: Wolfgang Punjer DL8VX, PO Box 90 11 30, D-2100 Hamburg 90, Federal Republic of Germany. A free 12-month subscription to *RTTY*, the official organ of GARTG, will be sent to the 3 top scorers of group A.

JAMBOREE-ON-THE-AIR

Starts: 0001 GMT October 16
Ends: 2400 GMT October 17

It's Jamboree time again! Time for Scouts, former Scouts, and anyone interested, to meet on the air for a weekend of good Scout talk. It gives amateurs and Scouts worldwide a chance to listen to or talk with other Scouts. In some cases,

CALENDAR

Oct 2-3	California QSO Party
Oct 2-4	Side Winders on Two Open QSO Party
Oct 9-10	GARTG Worldwide SSTV Contest (Part 2)
Oct 9-11	Side Winders on Two Open QSO Party (Part 2)
Oct 16-17	ARCI QRP CW QSO Party
Oct 16-17	Pennsylvania QSO Party
Oct 16-17	BSOA Jamboree-on-the-Air
Oct 23-24	Maryland-District of Columbia QSO Party
Nov 6-7	ARRL Sweepstakes—CW
Nov 13	Australian Ladies ARA Contest
Nov 13-14	European DX Contest—RTTY
Nov 20-21	ARRL Sweepstakes—Phone
Nov 20-21	Trinidad & Tobago QSO Party
Dec 4-5	ARRL 160-Meter Contest
Dec 11-12	ARRL 10-Meter Contest
Dec 19	CARF Canada Contest
Jan 8	*73 Magazine* 40-Meter World SSB Championship
Jan 9	*73 Magazine* 80-Meter World SSB Championship
Jan 15-16	*73 Magazine* 160-Meter World SSB Championship

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✓See List of Advertisers on page 130

QSL OF THE MONTH: W7ILN

David F. Rollins of Las Vegas has the winning QSL this month. The idea is really novel. The basic design (shown here) is desert flora set off against a desert background. David colors the card with colored pens, and no two cards are exactly alike. The textured paper makes the color have "depth"—the color card David sent in is really superb.

If you would like to enter our QSL card contest, put your QSL card *in an envelope*, along with your choice of a book from *73*'s Radio Bookshop, and send it to *73 Magazine*, Pine Street, Peterborough NH 03458, Attn: QSL of the Month. Entries which do not use an envelope or do not specify a book will not be considered.

SPLATTER!

NEWSLETTER OF THE MONTH

This month's winner is *Splatter*, the publication of the Radio Society of Bermuda. The newsletter is published in Hamilton, Bermuda. In addition to the usual club minutes, etc., the May issue had some interesting technical articles and an article on the world's biggest church, which was built by mistake. It seems that the architect's specifications were in feet, but the church was built in meters. *Splatter* also has a letter from the President of the Bermuda Radio Society with his comments on the proposed US phone band extension. In the news briefs departments, there is a note that the VP9 amateurs do not yet have approval to use the 10-MHz band. Although Bermuda is under the British flag, the amateur license structure in the colony is such that special approval is needed before new bands are authorized. Ah, bureaucracy.

Splatter has consistently good layout and its articles are always written in clear, concise language. A pair of charts, one each for resistors and capacitors, is included. The RSB announces their competitions in the newsletter and includes the appropriate forms, ensuring that all the members receive them in time. Cartoons and good drawings are in every issue, contributing to an overall outstanding newsletter.

The newsletter contest is enjoyed by us here at *73*, in spite of the work involved. We encourage all ham radio clubs in the US and overseas to send us a copy of their newsletter every month. We also like to get specialty newsletters such as those for VHF, DX, SSTV, RTTY, and so forth. There is always an array of outstanding newsletters. The competition is always close, so if your newsletter did not win this month, next month may be your turn.

where equipment is available for slow-scan television, to see them also. By the way, this also includes Girl Scouts, Guides, and all Scout leaders.

Look for stations at camporees and other Scout events and for K2BSA, the national headquarters amateur radio club station, and HB9S, the World Scout Bureau station.

Most operations will occur during the period of 0001 GMT Saturday to 2400 GMT Sunday, but since this is not a contest, operations may start Friday and go into Monday. No required contact format, no specific exchange, just Scouting fun. All operations must, however, adhere to FCC rules and regulations.

FREQUENCIES:

Scout frequencies published by the World Bureau are as follows:

Phone—3940, 7240, 14290, 21360, 51150.

CW—3590, 7030, 14070, 21140, 28190.

SSTV and RTTY on usual frequencies.

Post-card-size certificates issued by the World Bureau are available from JOTA Coordinator, Harry Harchar W2GND, 216 Maxwell Avenue, Hightstown NJ 08520, for anyone participating. Send one SASE with sufficient return postage—one ounce per eight cards. They may be requested before the JOTA weekend for distribution then, or for award at Scout Courts of Honor or other meetings.

Logs or lists of participants are *not required*, but reports of activity and photos are welcome for inclusion in the BSA report to the World Bureau and possible use in Scout publications. Send them to the JOTA Coordinator mentioned above.

PENNSYLVANIA QSO PARTY

1700 GMT Oct 16 to
0400 GMT Oct 17
1300 GMT Oct 17 to
2200 GMT Oct 17

Sponsored by the Nittany Amateur Radio Club, this is the 25th annual event. Stations may be worked once per mode (phone and CW) on each band. Mobiles may be reworked as they change counties. Repeater contacts are not permitted.

EXCHANGE:

RS(T), 3-digit sequential serial number, and ARRL section or Pennsylvania county. Stations on county lines will give out one number but the two counties will count as two separate multipliers.

FREQUENCIES:

SSB—3980, 7280, 14280, 21380, 28580.

CW—40 kHz up from bottom of CW bands.

Novice—10 kHz up from bottom of Novice subbands.

SCORING:

Count 1 point for SSB QSOs, 1.5 points for CW QSOs, and 2 points for 80-meter CW QSOs. Pennsylvania stations multiply QSO points by the total number of ARRL sections plus the total number of Pennsylvania counties plus a maximum of one DX country. Others, multiply QSO points by the total number of Pennsylvania counties worked (67 max.).

AWARDS:

This year, in addition to the usual certificates, plaques will go to top scorers in both Eastern and Western Pennsylvania, top out-of-state station, top mobile station (assuming at least 3 entries), and top multi-operator entry.

ENTRIES:

Logs must be complete, be legible, and include a summary sheet. Also include a dup sheet for entries with over 100 QSOs. Send logs no later than November 15th to: Douglas R. Maddox W3HDH, 1187 S. Garner Street, State College PA 16801.

ARCI QRP CW QSO PARTY

Starts: 1200 GMT October 16
Ends: 2400 GMT October 17

The contest is open to all amateurs and all are eligible for the awards. Stations may be worked once per band for QSO and multiplier credits. Participants may operate a maximum of 24 hours during the contest period.

EXCHANGE:

Members—RST, state-province-country, and QRP number. Nonmembers—RST, state-province-country, and power output. Novices and Technicians add /N or /T after the QRP number or power.

SCORING:

RESULTS

THE 1981 MARYLAND-D.C. QSO PARTY†

NON-MARYLAND STATIONS

Callsign	Total QSOs	Mult.	Score	Power	Mode
W2EZ	22	14	561	A	CW/SSB
WB2IPX	18	12	324	A	CW/SSB
W4FOA	13	10	195	A	CW/SSB
KA1HB	15	8	180	A	CW
WB1GLH	11	10	165	A	CW/SSB
AD8J/3	13	11	143	B	SSB
KF1B	12	10	120	B	SSB
W5PWG	12	6	108	A	SSB
WD8OYF	10	7	105	A	SSB
VE1RQ	9	7	94.5	A	SSB
G5EBU	12	5	90	A	CW/SSB
NØCZO	6	6	54	A	SSB
N1RI	6	4	36	A	SSB
VE5AAD	3	3	13.5	A	SSB
WA7JUJ	3	3	13.5	A	SSB
KD4PP	2	2	6	A	SSB
NØCLV	3	3	4.5	A	SSB(QRP)
W2CC	1	1	1.5	A	SSB
WA3JXW	1	1	1.5	A	SSB

MARYLAND-D.C. STATIONS

Callsign	County	Total QSOs	Mult.	Score	Power	Mode
WB3CFD	Allegany	685	100	68500	B	SSB
WA3VUQ	Howard	400	84	33600	B	SSB
WB3FNS	D.C.	188	72	20304	A	SSB
KS4B/3	St. Marys	206	55	16995	A	SSB
N3AC/M	*	70	36	3780	A	CW/SSB
WA3YHE	Montgomery	55	30	2475	A	SSB
W3ABC	Prince Georges	36	18	972	A	CW/SSB
WB3BSH	Dorchester	28	15	630	A	SSB
WA3EOP	Washington	18		#		SSB

*N3AC was mobile in Kent, Talbot, Cecil, Queen Annes, Baltimore, Frederick, Caroline, and Howard Counties.

#WA3EOP (check logs)

Power: A 200 Watts or less; B > 200 Watts.

Underlined callsign means awarded certificate.

†Next MDC QSO Party 1800Z Oct. 23 to 2100Z Oct. 24, 1982

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Tote 'n Talk Cordless Base/Telephone	149.00
NEW Signal/One Milspec	Soon
Permitron Wireless Burglar Alarm 3 Remotes	199.00
W6TOG Kits	Stock
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Demo TS530S	600.00
Alpha 78AE (Hi Serial No.)	2795.00
Kantronics Interface	169.00
Santec HT1200 + Batt cord	269.00
Amphenol Silver Plate PL259	1.00 ea.
Belden 99258, RG8X	19¢ ft.
8214, RG8 foam	36¢ ft.
8267, RG213	43¢ ft.
8448, Rotor	27¢ ft.
9405, HD Rotor	45¢ ft.
AEA MBARO	269.00
MM2	125.00
CK2	89.00
Robot 800A	749.00
400	675.00
Butternut HF6V	125.00
Saxton 450 OHM Openwire Line	20¢ ft.

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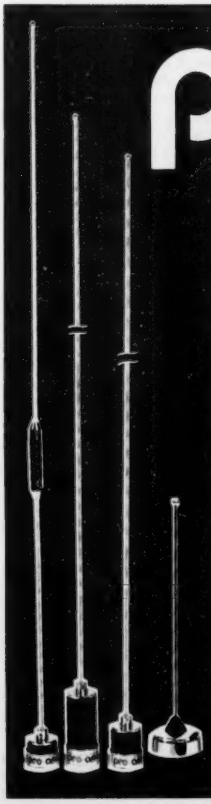

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✓See List of Advertisers on page 130

Each member QSO counts 5 points regardless of location. Nonmember QSOs are 2 points with US and Canadian stations, others are 4 points each. Nonmember Novice and Technician contacts count 3 points. Multipliers are as follows: 4-5 Watts, × 2; 3-4 Watts, × 4; 2-3 Watts, × 6; 1-2 Watts, × 8; less than 1 Watt, × 10. Entries from stations running more than 5 Watts output will count as check logs only. Stations are eligible for the following bonus multipliers: if 100% natural power (solar, wind, etc.) with no storage, × 2; if 100% battery power, × 5.

Final score is total QSO points times total number of states/provinces/countries per band times the power multiplier times the bonus multiplier (if any).

Note: VHF/UHF contacts must be direct—no repeater contacts are allowed.

FREQUENCIES:

1810, 3560, 7040, 14060, 21060, 28060, 50360.

Novice/Tech—3710, 7110, 21110, 28110.

All frequencies plus/minus to clear QRM.

AWARDS:

Certificates to the highest-scoring station in each state, province, or country with 2 or more entries. One certificate to highest-scoring Novice/Technician overall. Entries automatically considered for annual Triple Crowns of QRP Award.

LOGS AND ENTRIES:

Separate log sheets are suggested for each band for ease of scoring. Send full log data including full name, address, and bands used, plus work sheet showing details and time(s) off air. No log copies will be returned. Please indicate if you are a Novice or Technician. All entries desiring results and scores please enclose a business-size envelope with return postage for one ounce or an IRC. It is a condition of entry that the decision of the ARCI QRP Contest Chairman is final in case of dispute. Logs must be received by November 20th to qualify. Send all logs and data to: ARCI QRP Contest Chairman, William W. Dickerson WA2JOC, 352 Crampton Drive, Monroe MI 48161.

MARYLAND-DISTRICT OF COLUMBIA QSO PARTY

Starts: 1800 GMT October 23
Ends: 2100 GMT October 24

Sponsored by the Columbia Amateur Radio Association, the contest is open to all single-operator stations. The same station may be worked on each band and mode.

EXCHANGE:

QSO number; RS(T); and state, province, country, or MD county. Remember that Baltimore and Washington are independent cities!

SCORING:

MDC stations multiply total QSOs by the sum of Maryland counties, states, provinces, and countries. Others multiply MDC QSO total by number of Maryland counties and independent cities (25 max.). Also, multiply score by 1.5 if running 200 Watts or less.

FREQUENCIES:

Phone—3950, 7250, 14290, 21390, 28590.

CW—60 kHz up from low end.

Novice—3720, 7120, 21120, 28120.

AWARDS AND ENTRIES:

Maintain a continuous log for phone and CW but indicate on entry which category—phone, CW, or mixed—you are entering. Certificates for top scorers in each category will be awarded. Mail logs, dup sheets (for over 200 contacts), and summary by November 30th to CARA, c/o Robert K. Nauman WA3VUQ, 4017 Font Hill Drive, Ellicott City MD 21043.

SIDE WINDERS ON TWO (SWOT) OPEN QSO PARTY

Part 1
Starts: 0000 GMT October 2
Ends: 0600 GMT October 4

Part 2
Starts: 0000 GMT October 9
Ends: 0600 GMT October 11

This is the fifth annual QSO party sponsored by the SWOT Amateur Radio Club and open to all licensed amateurs with operating privileges on two meters. All entries must be single operator and contacts must be direct—no repeaters or satellites. Contacts must be on SSB or CW and each station can be counted only once. All contacts must be made from one geographic location. Portables or mobile stations operating from more than one county may submit the highest score for any one location. There are no time limitations within the contest period.

EXCHANGE:

Callsigns, signal reports, ARRL section, SWOT number, and USA county or equivalent.

SCORING:

Contacts with SWOT members count 2 points per QSO, others count 1 point each. The multiplier is the number of counties worked. Final score is QSO points times county multiplier.

ENTRIES:

Logs should not be submitted unless requested. Send only a summary postmarked no later than November 1st to: Jerome Doerrie K5IS, Rt. 2 Box 72, Booker TX 79005. The summary should contain: your name, call, address, ARRL section, SWOT number, total SWOT QSOs, total nonmember QSOs, total counties, and final score.

AWARDS

TREASURE ISLAND DXPEDITION

The Garden State ARA (W2GSA) will hold its 3rd annual special event: the Treasure Island DXpedition, located in the Manasquan River, Monmouth County NJ. The event is to commemorate the stay of Robert Louis Stevenson on the island after he wrote the book of the same name.

Date: October 2-3, 1982; time: 1400 to 1400; frequencies: CW—3.535, 14.035; SSB—3.900-7.235, 21.375-28.725. QSL certificate: $1.00 to Lou Eloe WA2SSH, 7 Carol Ave., Neptune NJ 07753. No postage necessary.

NUCLEAR ANNIVERSARY

The Argonne Amateur Radio Club plans to operate the Club's memorial station, W9QVE, to commemorate the 40th anniversary of the first controlled nulcear chain reaction experiment. This experiment was conducted at the Alonzo Stagg field on the University of Chicago campus.

Two stations will operate from 1500 GMT on October 9, 1982, through 2300 GMT, October 10th.

Frequencies: SSB—3985, 7285, 14285, 21285, 28585; CW—3545, 7045, 14045, 21045, 28045, 3765, 7165, 21165 Novice bands; RTTY—14090 and 146.70 MHz; 2 meter—145.19/144.59 rptr, 146.52 and 147.42 simplex.

Send business-size SASE or $1.00 for 8×11 unfolded certificate to AARC, PO Box 275, Argonne IL 60439.

SUNBELT EXPO

The Colquitt County Ham Radio Society will be operating club station WD4KOW from the site of the fifth annual Sunbelt Agricultural Exposition on October 12, 13, and 14, 1982. The hours of operation will be 0900 to 1700 EDST each day.

This annual Expo is held each year at Spence Field Airbase, located near Moultrie, Georgia, and is the largest agricultural show in the South. This event draws over 200,000 visitors from all over the United States and foreign countries.

Operations will be in the General portion of the HF bands. The members will also be listening for visiting hams on the local repeater, 146.19/.79. Visiting hams are invited to visit the amateur booth at the Expo and operate the amateur station.

A special QSL card is available for those making contact during this event and submitting an SASE. For more information, contact Joel Goings AA4P, PO Box 813, Moultrie GA 31768, or call (912)-985-3620.

NEWNAN GA

The Bill Gremillion Memorial Radio Club will operate K4SEX for county hunters on Saturday, October 2. Frequencies: General-class portion of phone bands on 10, 15, 20, 40, and 80 meters. CW available. Send an SASE for confirmation to: Bill Gremillion Memorial Radio Club, PO Box 2327, Newnan GA 30264.

MOSCOW DXPEDITION

Moscow MI: The Hillsdale County Radio Association will hold its 2nd Annual Moscow DXpedition to Moscow, Michigan on October 16 from 1700Z to 1700Z October 17, under the call WB8HIZ. The frequencies to be used: 3.940, 7.260, 14.285, 21.360, 50.120, 52.525, 144.310, 146.57 MHz, or as band conditions permit. The exchange will be signal report, name, QTH (except Moscow station: serial number). All QSLs with an SASE will be answered with a 9"x11" certificate. Mail to: Ham, PO Box 206, Moscow MI 49257.

HERITAGE HOLIDAYS

The Coosa Valley Amateur Radio Club will operate from Rome GA from 1200Z October 9 to 2200Z October 17 to commemorate Heritage Holidays. 25 kHz on the lower side of the General-class phone band—80 through 20 meters. Special certificate for a large SASE. Wagon Train mobile on Oct. 16. Endorsement to CVARC, Box 183, Rome GA 30161.

HAM HELP

We are happy to provide Ham Help listings free, on a space-available basis. We are not happy when we have to take time from other duties to decipher cryptic notes scrawled illegibly on dog-eared post cards and odd-sized scraps of paper. Please type or print your request (neatly!), double spaced, on an 8½"×11" sheet of paper and use upper- and lowercase letters where appropriate. Also, please make a "1" look like a "1," not an "l," which could be an "el" or an "eye," and so on. Hard as it may be to believe, we are not familiar with every piece of equipment manufactured on Earth for the last 50 years! Thanks for your cooperation.

I need the following equipment: URM-124, TS1325/TRC-75, TS1324/TRC-75 (also need test sets for this), GRM-21, CU-749/TRC-75, and C2848/TRC-75 (also need antenna coupler for this).

I also need the following modules (these are for the R761/ARC-58): AM 1528B/URC, CV465C/URC, SG-179A/URC, and SG-179B/URC.

I also need the following: AT-197/GR (antenna), TT98/FG (Teletype™), MK-731/ARC-51X (maintenance kit), ARC-134 (radio), ARC-54, 618T, PRC-74B, APA-69 (DF group), RT 524/VRC or RT 246/VRC, OA-3633/GRC, PRC-47, R1149/ARC-58(V), C1939/ARC-58, R1051/URR, URC-9, R220/URR or R640/URR, ARM-48 test set, ARM-47 test set, and ARM-11C.

I will pay reasonable costs for any of the above. Thank you.

Leroy Ritta
PO Box 102
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Australia

I have recently moved to West Haven CT and would like to join an amateur radio club in the area.

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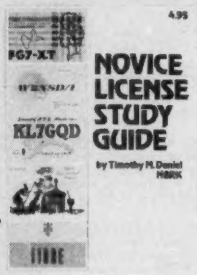

● **NOVICE LICENSE STUDY GUIDE**—by Timothy M. Daniel N8RK. Here is the most up to date novice guide available. It is complete with information about learning Morse Code, has the latest FCC amateur regulations and the current FCC application forms. This guide *is not* a question/answer memorization course but rather it emphasizes the practical side of getting a ham license and putting a station on the air. It reflects what the FCC expects a Novice to know without page after page of dull theory. The most current information still available at last year's price. SG7357 $4.95.*

● **NOVICE STUDY TAPES**—If you are just getting started in ham radio, you'll find these tapes indispensable! This up-to-the-minute revision of the 73 Study Course is the perfect way to learn everything you need to breeze through the Novice written exam. Theory, FCC regulations, and operating skills are all covered, and you'll be amazed at how fast you learn using these tapes!

Once the test is behind you, these tapes will go right on being useful, because they are packed with the latest information on setting up your own ham station, and getting on the air.

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GENERAL LICENSE STUDY GUIDE—By Timothy M. Daniel N8RK This is the complete guide to the General License. Learning rather than memorizing is the secret. This is not a question-and-answer guide that will gather dust when the FCC issues a new test. Instead, this book will be a helpful reference, useful long after a ham upgrades to General. Includes up-to-date FCC rules and an application form. Order yours today and talk to the world. SG7358 $6.95

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***NOTE—Above address for Binders only.**

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"GENESIS"

5 WPM—CT7305—This is the beginning tape for people who do not know the code at all. It takes them through the 26 letters, 10 numbers and necessary punctuation, complete with practice every step of the way using the newest blitz teaching techniques. It is almost miraculous! In one hour many people—including kids of ten—are able to master the code. The ease of learning gives confidence to beginners who might otherwise drop out.

"THE STICKLER"

8+ WPM—CT7306—This is the practice tape for the Novice and Technician licenses. It is made up of one solid hour of code, sent at the official FCC standard (no other tape we've heard uses these standards, so many people flunk the code when they are suddenly—under pressure—faced with characters sent at 13 wpm and spaced for 5 wpm). This tape is not memorizable, unlike the zany 5 wpm tape, since the code groups are entirely random characters sent in groups of five.

"BACK BREAKER"

13+ WPM—CT7313—Code groups again, at a brisk 14 per so you will be at ease when you sit down in front of the steely-eyed government inspector and he starts sending you plain language at only 13 per. You need this extra margin to overcome the panic which is universal in the test situations. When you've spent your money and time to take the test, you'll thank heaven you had this back-breaking tape.

"COURAGEOUS"

20+ WPM—CT7320—Code is what gets you when you go for the Extra class license. It is so embarrassing to panic out just because you didn't prepare yourself with this tape. Though this is only one word faster, the code groups are so difficult that you'll almost fall asleep copying the FCC stuff by comparison. Users report that they can't believe how easy 20 per really is with this fantastic one hour tape.

"OUTRAGEOUS"

25+ WPM—CT7325—This is the tape for that small group of overachieving hams who wouldn't be content to simply satisfy the code requirements of the Extra Class license. It's the toughest tape we've got and we keep a permanent file of hams who have mastered it. Let us know when you're up to speed and we'll inscribe your name in 73's CW "Hall of Fame."

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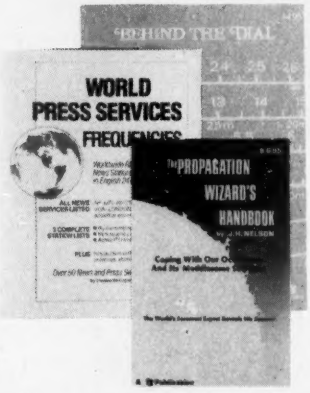

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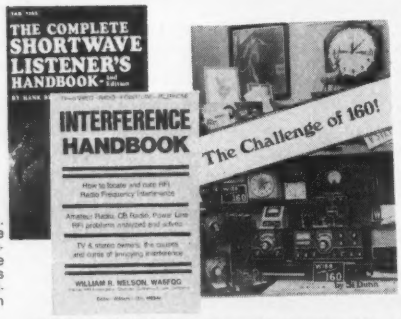

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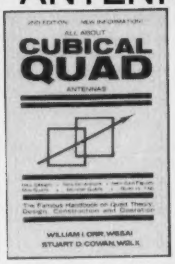

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READER SERVICE

This card valid until November 30, 1982.

A. Which of the following best describes your involvement in electronics?
- ☐1. Strictly a hobby
- ☐2. Strictly business
- ☐3. Both hobby and business

B. Do you own a microcomputer?
- ☐1. Yes
- ☐2. No

C. If you answered yes to Question B, which of the following applies:
- ☐1. I use my microcomputer entirely for amateur radio.
- ☐2. I use my microcomputer for several things, including amateur radio.
- ☐3. I don't use my microcomputer for amateur radio.

D. Which band(s) do you usually operate on?
- ☐1. 2
- ☐2. 6
- ☐3. 10
- ☐4. 15
- ☐5. 20
- ☐6. 40
- ☐7. 80
- ☐8. 160
- ☐9. Other_____

E. Which of the following best describes your interest in TVRO (satellite TV)?
- ☐1. I currently own a TVRO.
- ☐2. I will build or buy a TVRO in the near future.
- ☐3. I'm interested in learning more about satellite TV.
- ☐4. I am not interested in satellite TV.

F. Which 73 ads do you find most interesting?
- ☐1. Almost all ads
- ☐2. About half the ads
- ☐3. Mostly full page ads
- ☐4. Mostly color ads
- ☐5. Ads for products of specific interest
- ☐6. Don't look at ads

G. How do you rate the visual appeal of ads in *73 Magazine*?
- ☐1. Excellent
- ☐2. Good
- ☐3. Fair
- ☐4. Poor

H. I would like to see more of the following types of articles in *73 Magazine* (check all that apply):
- ☐1. Equipment modifications
- ☐2. Simple construction articles
- ☐3. Complex construction articles
- ☐4. Historical
- ☐5. Antennas
- ☐6. Operating news
- ☐7. Theory
- ☐8. Beginner
- ☐9. Humor

I. What do you think of the saddle stitch binding now being used on *73 Magazine*?
- ☐1. Love it
- ☐2. Ok, no better than the old binding
- ☐3. Bring back the old binding
- ☐4. Don't care

J. Which amateur radio magazines do you read regularly
- ☐1. *73 Magazine*
- ☐2. *QST*
- ☐3. *Ham Radio*
- ☐4. *CQ*
- ☐5. Other_____

K. What is your annual household income?
- ☐1. Under $20,000
- ☐2. $20,000—$40,000
- ☐3. $40,000—$60,000
- ☐4. $60,000—$80,000
- ☐5. $80,000—$100,000
- ☐6. Over $100,000

Reader Service: Return this card to receive full information on the products advertised in this issue. Refer to the add. You will find numbers near the logo of each advertiser. Each represents the advertiser's individual Reader Service Number. Circle the corresponding numbers on the card on this page, include your name, address & zip, and drop in a mailbox. In 4-6 weeks you'll hear from the advertiser directly.

1	6	11	16	21	126	131	136	141	146	251	256	261	266	271	376	381	386	391	396
2	7	12	17	22	127	132	137	142	147	252	257	262	267	272	377	382	387	392	397
3	8	13	18	23	128	133	138	143	148	253	258	263	268	273	378	383	388	393	398
4	9	14	19	24	129	134	139	144	149	254	259	264	269	274	379	384	389	394	399
5	10	15	20	25	130	135	140	145	150	255	260	265	270	275	380	385	390	395	400
26	31	36	41	46	151	156	161	166	171	276	281	286	291	296	401	406	411	416	421
27	32	37	42	47	152	157	162	167	172	277	282	287	292	297	402	407	412	417	422
28	33	38	43	48	153	158	163	168	173	278	283	288	293	298	403	408	413	418	423
29	34	39	44	49	154	159	164	169	174	279	284	289	294	299	404	409	414	419	424
30	35	40	45	50	155	160	165	170	175	280	285	290	295	300	405	410	415	420	425
51	56	61	66	71	176	181	186	191	196	301	306	311	316	321	426	431	436	441	446
52	57	62	67	72	177	182	187	192	197	302	307	312	317	322	427	432	437	442	447
53	58	63	68	73	178	183	188	193	198	303	308	313	318	323	428	433	438	443	448
54	59	64	69	74	179	184	189	194	199	304	309	314	319	324	429	434	439	444	449
55	60	65	70	75	180	185	190	195	200	305	310	315	320	325	430	435	440	445	450
76	81	86	91	96	201	206	211	216	221	326	331	336	341	346	451	456	461	466	471
77	82	87	92	97	202	207	212	217	222	327	332	337	342	347	452	457	462	467	472
78	83	88	93	98	203	208	213	218	223	328	333	338	343	348	453	458	463	468	473
79	84	89	94	99	204	209	214	219	224	329	334	339	344	349	454	459	464	469	474
80	85	90	95	100	205	210	215	220	225	330	335	340	345	350	455	460	465	470	475
101	106	111	116	121	226	231	236	241	246	351	356	361	366	371	476	481	486	491	496
102	107	112	117	122	227	232	237	242	247	352	357	362	367	372	477	482	487	492	497
103	108	113	118	123	228	233	238	243	248	353	358	363	368	373	478	483	488	493	498
104	109	114	119	124	229	234	239	244	249	354	359	364	369	374	479	484	489	494	499
105	110	115	120	125	230	235	240	245	250	355	360	365	370	375	480	485	490	495	500

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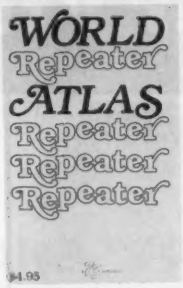

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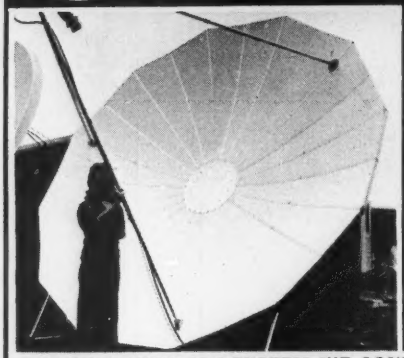

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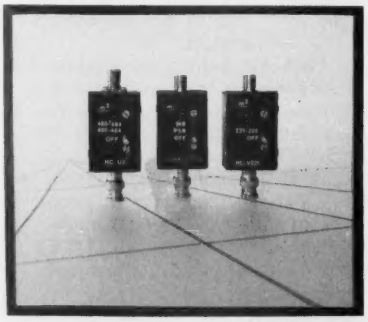

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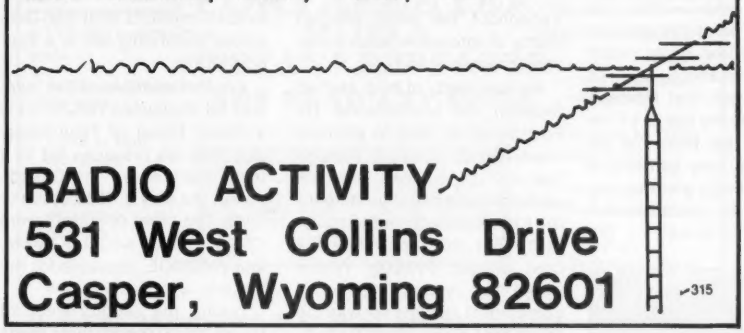

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DX

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NAVASSA ISLAND KP2A/KP1

An automated lighthouse caps the tiny island of Navassa, a few miles off the coast of Haiti. Navassa meets the sea in an unbroken ring of high cliffs, with no safe harbor or landing site. It lies 15 hours from the nearest assistance by boat and even further from help by any other means. But Navassa's status as a separate "country" under ARRL DXCC rules ensures a continuing flow of DXers to the island.

The latest and most successful such DXpedition invaded Navassa this last March, under the auspices of the International DX Foundation. One member of that trip, Terry Baxter N6CW, related his experiences to me at the International DX Convention in Visalia CA last April. Thanks to Terry for this story.

John Ackley KP2A had often thought of a DXpedition to nearby Navassa. The island is perfect for such a trip: It is within a reasonable boat ride from well-stocked ports; licensing is automatic, as it is part of the United States; the Coast Guard is reasonable about issuing landing permission; and it is a known quantity. In other words, you know exactly what you are getting into, unlike some more disputed DX locations, such as Spratly. The fact that Navassa did not rank in the top 73 of the most wanted list from *The DX Bulletin* survey (the benchmark of all such listings) was the only drawback to the operation. But increasing interest in DX throughout the world ensured plenty of interest in such a trip. John pressed ahead.

The KP2A/KP1 crew at Lulu Bay on Navassa. From left: WA2MOE, KP2A, W0DX/VP2VI, K0OO, W2IJB, N2OO, K1MEM; N6CW in back.

He had plenty of help. He had founded the International DX Foundation in 1978 to promote international goodwill through just such DXpeditions. The IDXF would provide major funding for the trip, especially for the equipment. But the trip would still cost almost $10,000. Where would the rest of the money come from? The answer was the same that many other DXpeditions have used: Get more operators and divide the costs among them.

Finding amateurs with the funds, the free time, and the inclination to travel to Navassa was not easy. An early recruit was Bob Denniston W0DX/VP2VI, from the neighboring British Virgin Islands. Bob's illustrious amateur career has included the presidency of the ARRL and the IARU. He also organized the first DXpedition to Clipperton Island in 1954 and is one of the few amateurs ever to return there. He claims two trips to Malpelo as well, including the first radio operation from that rock. Bob presently runs a small hotel on Tortola in the BVI and is active in CW contests and on 160 meters. An amateur of Bob's experience was a great plus in a major DXpedition.

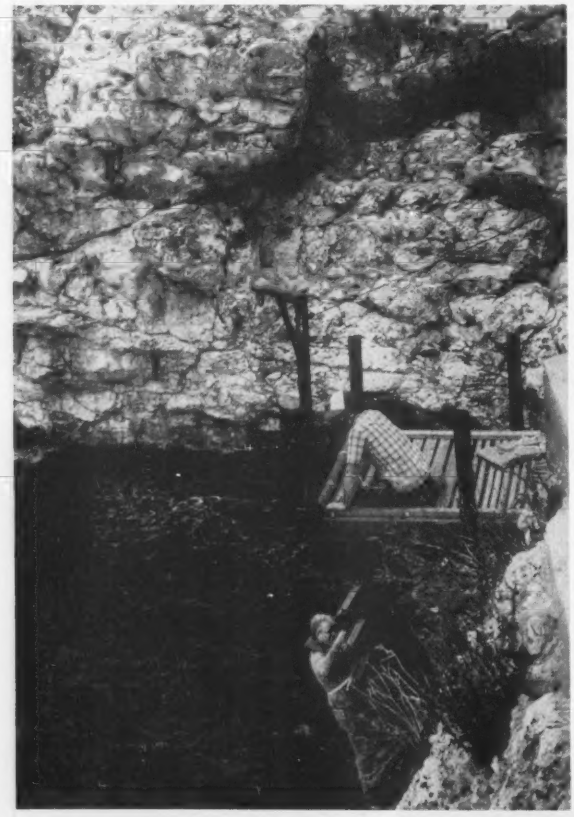
The cast of characters continued to assemble. Hams with DXpedition experience and operating expertise were lined up. A former president of the San Diego DX Club, Terry Baxter N6CW, was a frequent visitor to the British Virgin Islands, especially during the *CQ* WW CW contests, when he would operate as VP2VDH. Terry's eyeball contacts with Bob Denniston eventually led to a spot on the trip.

Another member of the team was Ed Magnuson W2IJB. Ed is a Senior Editor of *Time* magazine, and his presence led to a feature article on the DXpedition in the May 3, 1982, issue of *Time*. The other operators were K8CW, N2OO, K0OO, K1MEM, and WA2MOE. The time for the trip was approaching.

During the second week of March, the DXpeditioners made their own way to Kingston, Jamaica, the nearest staging point for the DXpedition. Although Navassa lies far closer to Haiti than to Jamaica, it is much closer to the port of Kingston than to the nearest port in Haiti, Port-au-Prince. And accommodations and supplies are far better in Jamaica.

By Sunday, March 14, all nine members of the operating team were in Jamaica. Dr. John Manley 6Y5MJ provided local support, scouting out a suitable boat and places to stay, and helping with the herculean task of assembling the necessary equipment to send nine operators and six crew members to Navassa. Food, water, gasoline, diesel fuel, barrels, steel pipe for masts, ropes, tents, and more were assembled. One has to anticipate every possible need and stock accordingly. And this list doesn't even include the radio equipment and antennas. When the nearest Radio Shack is days away, the lack of a single coaxial connector can be devastating.

By 6:00 pm on Monday, all the supplies were safely stowed on board the 48′ fishing boat



W2IJB climbs the infamous Navassa Ladder while K8CW provided moral support. Imagine hauling all the DXpedition material up this ladder, from a tiny dinghy tossing in the waves!

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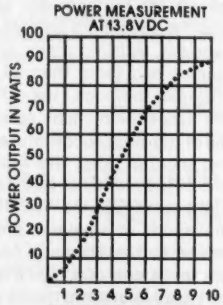

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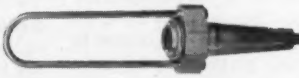

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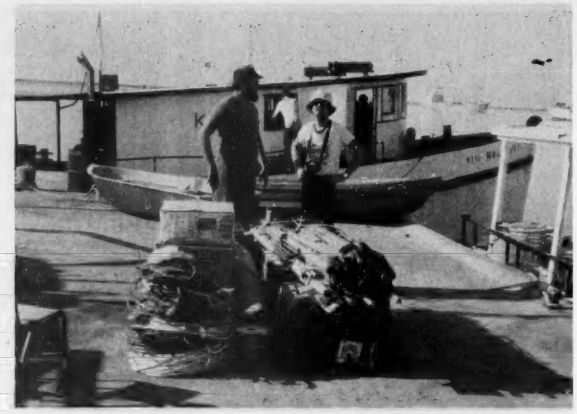
W2IJB and K1MEM in front of one of the operating positions. Note the hill in the background blocking the path to Europe.



K@OO and K1MEM examine a small fraction of the DXpedition equipment and supplies in Kingston, Jamaica, before boarding the boat Gabriella *for Navassa.*

Gabriella and the DXpedition shoved off. For the next 15 hours, the sturdy boat battled the current and trade winds, fighting its way 150 miles east and north toward the low silhouette of Navassa. And all night the amateurs discovered that proficiency at ham radio is no protection from the ills of seasickness. While it may be true that nobody has ever died of *mal de mer*, everyone so stricken certainly wishes he could. An inauspicious beginning to the trip; what would the next day bring?

At dawn, the *Gabriella* was anchored firmly off the Navassa landing site at Lulu Bay. There are exactly two ways to get from the anchorage to the island: the Coast Guard way, via helicopter, or the radio amateur way, via The Ladder. The Coast Guard description of access to the island includes this warning: "There is constant danger of the boat being broached by the incoming swell, being smashed against the cliff, being caught and crusted under the cliff, or being engulfed by the receding backwash." Instead of a landing, a steel and wire ladder hangs 40 feet down to near the water line. "Landing" at Navassa means maneuvering your dinghy under the steel ladder (presumably avoiding the aforementioned dangers) and, catching the 5'-10' swells just right, leaping out of the dinghy to the ladder. Then, an easy climb up two-foot rungs of angle iron to the tiny platform and you're ashore on Navassa.

Multiply this task by nine to get the operators ashore, and then think about moving the tons of equipment and supplies from the boat to the dinghy, under the ladder, and up to the island. Two generators, barrels of gasoline, four complete stations, 3 tribanders, an amplifier, food, water, and tents—all the hardware for a week-long DXpedition had to be shuttled in to the ladder and hauled up to the platform. But even that was not the end of the task. The platform is 50 feet below the nearest flat spot on the island. A set of rough stone steps leads up from the platform to the first, lower plateau. K8CW devised an ingenious cart which rolled up the ramp by the steps, until it failed under the heavy loads. Elbow grease and armstrong power prevailed, and the gear slowly began to accumulate on the lower plateau.

But suddenly *Gabriella*'s warning horn blasted. The hams on the island switched on their HTs to hear the chilling news that a couple of small, open boats had suddenly appeared and two men were climbing the ladder. Were the intruders some of the notorious pirates which frequent these waters? Haitians bent on revenge against the American oppressors? Stu Greene WA2MOE's fractured French soon allayed both fears. The Haitian fishermen had rowed across 40 miles of open water in tiny rowboats looking for better fishing grounds. They would be pleased to help unload the dinghy and haul the hundreds of pounds of remaining equipment up to the operating site in exchange for some food. The deal was quickly struck and the amateurs resumed the task of assembling the actual stations. Even with the help of the fishermen, it took two days to transport all the gear from the *Gabriella* to Navassa.

Meanwhile, KP2A/KP1 struggled to get on the air. Having abandoned the original plan of transporting all the gear to the island first, John and the other amateurs concentrated on the generators and antennas. After all, the food and water could come over any time, but the whole world was waiting for the first QSO. And Tuesday night, KP2A/KP1 did indeed hit the airways, with the first of more than 33,500 QSOs.

The hams set up separate stations along the ledge. The higher frequency bands boasted TH3s on 20' steel poles. Dipoles sufficed for the lower bands, with the 40-meter dipole doubling as a 15-meter antenna during the day. Six meters was a big disappointment, with only 15 QSOs (all South Americans). But 160 meters made up for any lack of propagation on 6. Bob Denniston strung a dipole across an inlet of the ocean, nearly 100' above the water. He then made 87 separate trips back and forth between the rig and the antenna to properly tune the dipole. His perseverance paid off: KP2A/KP1 logged 522 QSOs on 160!

The other operators manned all the other stations, and averaged more than 4 QSOs per minute of operation! The hill to the northeast blocked European signals somewhat, but CW provided thousands of European contacts. In fact, the 33,000+ QSOs were evenly divided between SSB and CW, with many of the CW QSOs coming from outside the States. Eight percent of the stateside QSOs were on SSB. The six CW operators on Navassa were a fussy lot: Each brought his own keyer and paddle! The keyers and paddles crowded the tiny tables, but a major DXpedition is no time to learn someone else's keyer! The DXpedition avoided lists completely and even managed to work most contacts on frequency, only resorting to split-frequency operation a few times. Band conditions permitted barefoot operation on all but 20 meters in the evening, which helped reduce gasoline consumption to one barrel from the anticipated three.

During infrequent breaks in operating, the hams explored what little of Navassa is worth examining. Graffiti reading turned out to be the biggest thrill of the trip, as Coast Guard regulations prohibit alcoholic beverages on Navassa.

The time came to leave Navassa and the DXpedition crew began the long task of disassembling the gear and shuttling the equipment back to the *Gabriella*. With no major emergencies and more than 33,500 QSOs in the logs, the KP2A/KP1 DXpedition must rank as one of the most successful ever. And months later, the first of tens of thousands of QSL cards hit the mails (QSL via WB2MSH). Thousands of amateurs are indebted to the Navassa operators for "a new one." Let's hope the Heard Island trip meets with equal success.

(I would like to thank *Time* magazine, the International DX Foundation, *The DX Bulletin*, and especially Terry Baxter N6CW for the information in this month's column.)

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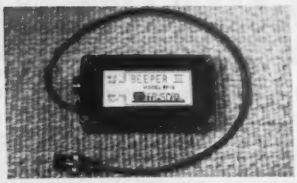

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RTTY LOOP

Marc I. Leavey, M.D. WA3AJR.
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Well, with this time of year comes the announcement of what has become an autumn tradition, the SCATS RTTY Art Contest. Mae Washburn WA6LNH, of the Southern Counties (California) Amateur Teleprinter Society, sends along the official announcement of this year's competition, which includes several changes from previous years.

The contest period is from September 1, 1982, to November 30, 1982, and is open to licensed amateurs worldwide. Entries must have been originated by means of *manual* input to a teleprinter using a standard communications keyboard. Sorry, folks, no computer-generated pictures! Either the amateur or an amateur's family member may be the originator. The subject matter must be "suitable for transmission via amateur radio."

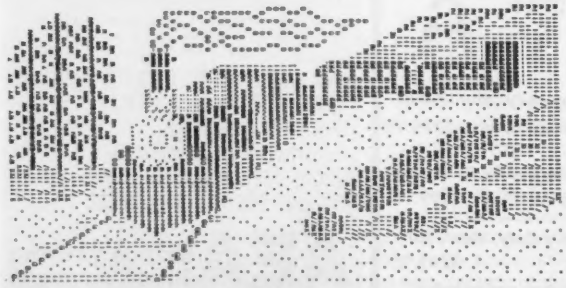
Tapes of entries should be five-level, 11/16th-inch-width, run no longer than 40 minutes at 60-wpm speed, and be unspliced. They should be compatible with machines which both do and do not downshift on space. For those of you who are confused by that, it means that if you are sending in uppercase (FIGS) and have to send one or more spaces, follow the space with another FIGS character. Conversely, if you are changing from upper- to lowercase, do not depend on the space to effect the change—send a LETTERS character. Got it?

More particulars: No need to worry about BELL and apostrophe problems—they will allow for that. Between you and me, though, I normally send one of each (that is FIGS-J and FIGS-S) to be sure that the apostrophe is printed. A line should terminate with a CAR-RET/LINE FEED/LETTERS sequence, at a minimum. I normally throw in an extra carriage return, though!

Now, an important difference from previous years is the limitation of each line to *68* characters, rather than 72. This is to accommodate some of the European equipment which was unable to display the longer line length.

The artwork must have been transmitted for the first time via amateur radio after September 1, 1982, and have written confirmation received. There are some more particulars, available in the full list of rules available from SCATS. Write to the RTTY Art Contest, c/o Norm Koch K6ZDL, PO Box 1351, Torrance CA 90505.

The winners of the 1981 contest, whose works are reprinted here, include Jean Carter KA6HJK of Buena Park CA, for her entry, "The Railroad." This is Jean's first year as a ham, her first entry in a RTTY Art contest, and she won the first prize! Second place went to Alfred La Vorgna WA2OQJ of Hicksville NY, for "A Prize In Every Box," and third place went to Charles Pike K3YUH of Monica PA, for his comical "What's Up, Doc?" Honorable mention saw a tie between Bent Pederson OZ5RT, of Copenhagen, Denmark, who submitted "The Wild Horse," and Richard Camp WA7NGN of Las Vegas NV, with "Freddy Fender." Why not try your hand this year, and see if your work can grace the pages of *73* next year?



First place: Jean Carter KA6HJK.

Several club newsletters cross my desk each month, and I would like to take a moment to acknowledge some of them. The Inland Empire RTTY Network, out in San Bernardino CA, puts out a nice mimeographed newsletter which describes their repeater and club functions. A nice map describing coverage areas and linkages of two-meter RTTY repeaters is a welcome addition to the paper. The Stark RTTY Group, in Massillon OH, has thoroughly revised its publication, *Watts Happening.* No longer a few hectographed sheets, it is now an impressive little booklet complete with features and ads. Terry Russ N8ATZ, the editor of the newsletter, has done a fine job and I'm sure the membership will benefit.

Also in the mail are letters. Oh, boy, are there letters! I am going to try to cut down this backlog over the next few months and put the questions of widest interest here in the column for all to see. This month, Kurt A. Theis WA6YDQ, from Citrus Heights CA, gets the spotlight. Kurt asks several questions which just delight the heart of a columnist like yours truly. I shall respond in order.

Kurt asks, "On the Model 15, under the carriage there are several bars running through a metal plate. On the plate are stamped certain characters, among them "TAB", "STOP", and "LF". Do the TAB and STOP have any use in ham RTTY and, if so, how do I make use of them?" Well, Kurt, the hunk of metal you are looking at is the blocking bail on a function lever. Several of the machine functions you note, most importantly TABulation, are available in specially-equipped machines. However, I know of no ham use for these functions, as they are not supported in the vast number of machines. And since the Teletype® Model 15 is no longer being manufactured, I guess not too many more will be coming out of the showroom so fully equipped.

Next, Kurt inquires, "I have read a couple of books on RTTY and come across a few things that I would like to try if possible. One of them is SELCAL. I would like to set this up in the shack but I don't know if it would be useful. Is SELCAL used very often in RTTY? Would it be better to use a microprocessor in the decoding or to just build a hardware device for it?" Been reading this column, Kurt? No, seriously, SELCAL, or SELective CALling, is a takeoff on a concept that has been bumping around RTTY for forty years. Originally mechanical, with wheels and disks, this was one of the first fronts to give way to digital electronics. These days, selective calling of one form or

Second place: Alfred La Vorgna WA2OQJ.

Third place: Charles L. Pike K3YUH.

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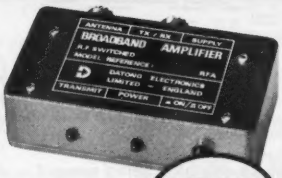

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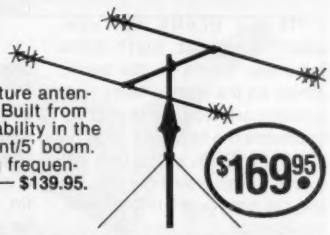

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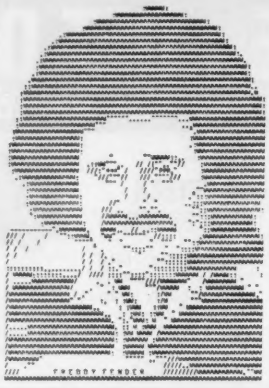
⌐See List of Advertisers on page 130

another is still quite in use, but with far more sophisticated techniques than in years past. For flexibility and ease of use, I don't think there is another way to go. If you want to implement this mode in 1982, then try a microprocessor. You might peruse back issues of *73*. Better yet, ask around the air to get a sense of the diversity of equipment in use.

We can deal with Kurt's third question easily. "Are regenerative repeaters used a lot any more, and are the surplus units lying around any good?" With few exceptions, no.

"Is the BLANK key ever used?" For what, Kurt? Some folks like to idle on the blank, others on the letters. Many tape systems are set up to shut down or disable the keyboard upon receipt of a blank, so it's best not to use it. You would not want to gag the guy you are in QSO with, would you?

Finally, "I have been listening in on some electronic mailboxes and others sending traffic and other personal messages via autostart. If the receiving operator is not there to answer back right away, wouldn't that be a one-way communication that the FCC keeps saying we can't use?" The problem here is not only one-way transmission, although that can be gotten around just as so-called "bulletin stations" have been doing for years, but the non-attended RTTY station. If the receiving station does just that, receive, I don't think you can get too upset. However, if the receiving station automatically takes to the air, unattended, to acknowledge receipt of a message without an operator being present, you are certainly skirting the law. Now, I know that even years ago there were WRU (Who Are You) and Answer Back circuits which did much the same thing, but they weren't any more legal back then. For me, I would feel much more comfortable not enabling a transmitter to answer unless there is a human control operator around to shut things down if something happens.



Honorable mention: Richard Camp WA7VGN.

Honorable mention: Bent Pedersen OZ5RT.

As I write this column, I have been looking around at various eight-inch disk systems (DS-DD) for my computer, a Smoke/GIMIX/6800 system. I am appalled at the dearth of information published or available on the various manufacturers' products. Not only that, but each manufacturer states that his drive is best, and adds how this one tears up media, or fails prematurely, or requires recall modifications to keep going. I don't know how anyone can make an informed choice.

Computer RTTY is leading the mechanical type in the mail by a wide margin, so I shall try to keep the main line where the action is. If you have a topic you wish to see covered in this column, feel free to drop me a line at the above address. I usually answer mail that has a self-addressed stamped envelope—not promptly, but I get there. Other mail is answered in this column only, and then only if it is of general interest. Watch closely: Some reviews of recently released commercial equipment may even find their way in here now and then.

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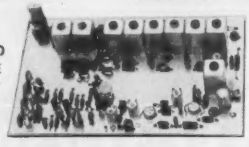

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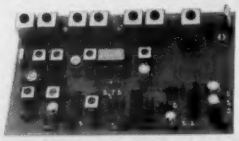

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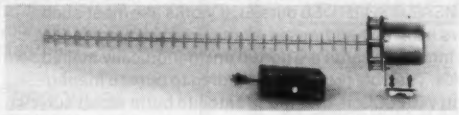

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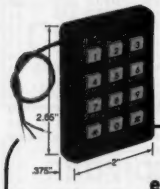

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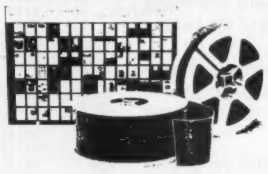

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SATELLITES

SATELLITE QSL BUREAU

One vastly under-utilized resource available to all amateur satellite users is the AMSAT-OSCAR QSL bureau. It works like most such bureaus: Operators keep self-addressed, stamped envelopes on file at the bureau and incoming cards are sorted and periodically mailed out in the envelopes. The only problem, according to bureau manager Bill Luebkemann WB2LCC, is that many satellite buffs aren't currently using the bureau, resulting in a large backlog of unclaimed cards. At midsummer, for instance, the bureau was holding some 1500 unclaimed cards for more than 700 different stations.

To receive cards from the bureau, send Bill up to six self-addressed, stamped #10 envelopes. Foreign stations may send IRCs instead of postage. Your callsign only goes in the upper left-hand corner where the return address would normally appear. Once a month, any cards on file for your station will be mailed using one or more of your envelopes.

Cards to be sent through the bureau should have the callsign of the intended recipient placed on the right rear of each card. The cards should then be put in alphabetical order before being shipped to the bureau. There is a five-cent charge for each card addressed to a station outside North America. All other services of the bureau are free.

For more details about the AMSAT-OSCAR QSL bureau, write to WB2LCC, 116 Country Farms Road, Marlton NJ 08053.

THE UoSAT SAGA

A 150-foot parabolic dish antenna was being used this summer in what appeared to be a last-ditch effort to save the ill-fated University of Surrey amateur satellite. The dish, which provides 42 dB gain at 435 MHz, will be used in an attempt to issue commands to the satellite.

The drastic action was made necessary when a software error caused both the 144- and 435-MHz beacons aboard UoSAT to be commanded on simultaneously. As a result, both command receivers are being desensed by the beacons. It is hoped that the very high erp of the big dish will be sufficient to overcome the desense problem and turn off one of the beacons. An earlier rescue attempt using the 26-dB 2-meter EME array of K1WHS proved unsuccessful despite Dave's considerable effort.

Thanks to the *AMSAT Satellite Report* for this information.—WB8BTH.

Amateur Satellite Reference Orbits

		OSCAR 8		RS-5		RS-6		RS-7		RS-8		
	Date	UTC	EQX	UTC	EQX	UTC	EQX	UTC	EQX	UTC	EQX	Date
Oct	1	0124	96	0054	261	0000	249	0002	248	0101	261	1
	2	0128	98	0048	261	0144	276	0152	277	0058	262	2
	3	0133	99	0043	261	0128	274	0142	276	0055	263	3
	4	0137	100	0038	261	0113	272	0133	276	0053	264	4
	5	0141	101	0032	261	0058	270	0123	275	0050	265	5
	6	0003	76	0027	262	0042	267	0113	274	0047	266	6
	7	0007	78	0022	262	0027	265	0104	273	0044	266	7
	8	0011	79	0016	262	0011	263	0054	272	0041	267	8
	9	0016	80	0011	262	0155	290	0044	271	0039	268	9
	10	0020	81	0006	262	0139	288	0035	270	0036	269	10
	11	0025	82	0000	262	0124	285	0025	269	0033	270	11
	12	0029	83	0154	293	0108	283	0015	269	0030	270	12
	13	0033	85	0149	293	0053	281	0006	268	0027	271	13
	14	0038	86	0144	293	0038	278	0155	297	0024	272	14
	15	0042	87	0138	293	0022	276	0146	296	0022	273	15
	16	0047	88	0133	293	0007	274	0136	295	0019	274	16
	17	0051	89	0128	294	0150	301	0127	294	0016	275	17
	18	0055	90	0122	294	0135	299	0117	293	0013	275	18
	19	0100	92	0117	294	0119	297	0107	292	0010	276	19
	20	0104	93	0112	294	0104	294	0058	291	0008	277	20
	21	0108	94	0106	294	0049	292	0048	290	0005	278	21
	22	0113	95	0101	295	0033	290	0038	290	0002	279	22
	23	0117	96	0056	295	0018	287	0029	289	0159	309	23
	24	0122	97	0050	295	0002	285	0019	288	0156	310	24
	25	0126	98	0045	295	0146	312	0009	287	0153	311	25
	26	0130	100	0040	295	0130	310	0000	286	0150	312	26
	27	0135	101	0034	296	0115	308	0149	315	0148	313	27
	28	0139	102	0029	296	0100	305	0140	314	0145	314	28
	29	0000	77	0024	296	0044	303	0130	313	0142	314	29
	30	0005	78	0018	296	0029	301	0120	312	0139	315	30
	31	0009	80	0013	296	0013	298	0111	312	0136	316	31
Nov	1	0014	81	0008	296	0157	326	0101	311	0134	317	1
	2	0018	82	0002	297	0141	324	0051	310	0131	318	2
	3	0022	83	0156	327	0126	321	0042	309	0128	318	3
	4	0027	84	0151	327	0111	319	0032	308	0125	319	4
	5	0031	85	0146	327	0055	317	0023	307	0122	320	5
	6	0036	87	0140	327	0040	314	0013	306	0119	321	6
	7	0040	88	0135	328	0024	312	0003	305	0117	322	7
	8	0044	89	0130	328	0009	310	0153	334	0114	323	8
	9	0049	90	0124	328	0152	337	0143	333	0111	323	9
	10	0053	91	0119	328	0137	335	0134	333	0108	324	10
	11	0058	92	0114	328	0122	332	0124	332	0105	325	11
	12	0102	94	0108	329	0106	330	0114	331	0103	326	12
	13	0106	95	0103	329	0051	328	0105	330	0100	327	13
	14	0111	96	0058	329	0035	325	0055	329	0057	327	14

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CORRECTIONS

Several errors crept into our two-part "Confessions of a Counter Evolutionary" article. In part I (August, 1982), line 9 of column 3 should read: "connections) and R6//R7."

In part II (September, 1982), the following corrections should be made:
- On Fig. 12 (page 39), pin 12 of IC26 must be connected to pin 9 of the IC before the common connection goes to pin 10 of IC35.
- In column 2 on page 42 of the article, line 11 should be changed to read "strobes 1-7, not 2-8."
- On page 42, column 4, paragraph 3, line 5 should read: "2x1¾-inch Bud 2100)."
- On Fig. 17 (page 44), eliminate the dashed box around the three 74LS04 chips. (Keep in mind that all three ICs are still 74LS04s.)
- On page 46, column 1, paragraph 1, line 5, the word "Yet" should be omitted.

Charles E. Martin AB4Y
***73 Magazine* Staff**

In the article "Double Trouble on 50 MHz" (September, 1982), the following corrections should be made:
- Q6 and Q7 are 2N1566*A* NPN transistors.
- The .001-microfarad capacitor should be a *fixed*, not variable, capacitor.

Charles E. Martin AB4Y
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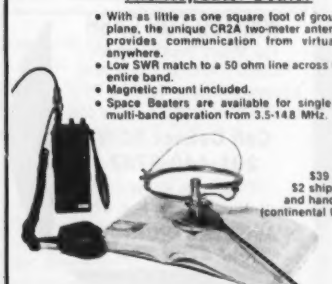

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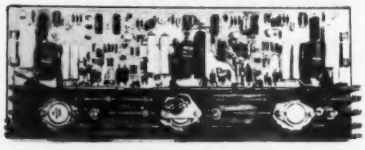
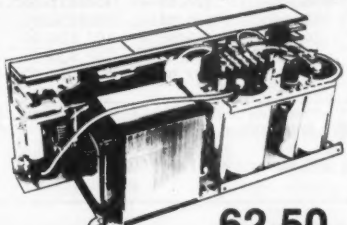


REGULATOR ASSEMBLY
(part of unit)



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Max. # of ch/line	80 alt. 132.	Char. Code	ECMA-6 7-bit coded char. set
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Char. Size Height	2.7mm/1/8"		
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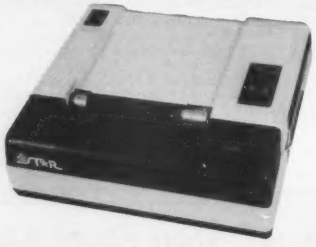

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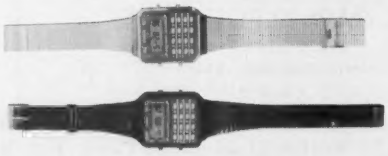

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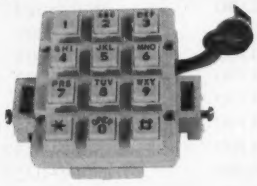

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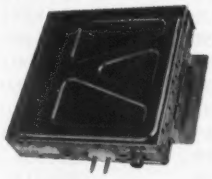

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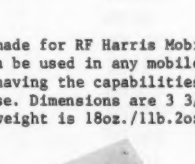
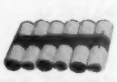
12vdc at 5Amp/Hr. $15.99

VHF DUPLEXERS

This duplexer was made for RF Harris Mobile Phones. These duplexers can be used in any mobile phone system, along with having the capabilities to be modified for UHF use. Dimensions are 3 3/5"Lx 4 2/5" Wx 1 1/10"D. App. weight is 18oz./1lb.2oz.



PRICE $74.99



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RF TRANSISTORS, MICROWAVE DIODES

PART	PRICE
1S2199	$ 7.50
1S2200	7.50
2N1561	25.00
2N1562	25.00
2N2857	1.55
2N2857JAN	2.55
2N2876	11.00
2N2947	18.35
2N2948	15.50
2N2949	3.90
2N2950	4.60
2N3375	8.00
2N3553	1.57
2N3632	13.80
2N3818	5.00
2N3866	1.30
2N3924	3.35
2N3927	17.75
2N3950	25.00
2N4072	1.80
2N4127	21.00
2N4427	1.30
2N4428	1.85
2N4957	3.45
2N4958	2.90
2N4959	2.30
2N5090	13.90
2N5108	4.00
2N5109	1.70
2N5160	3.45
2N5177	21.62
2N5179	1.00
2N5583	4.00
2N5589	8.65
2N5590	10.35
2N5591	13.80
2N5635	10.95
2N5637	15.50
2N5641	9.20
2N5642	10.95
2N5643	15.50
2N5645	13.80
2N5646	20.70
2N5691	18.00
2N5764	27.00
2N5836	5.45
2N5842	8.00
2N5849	20.00
2N5913	3.25
2N5922	10.00
2N5923	25.00
2N5941	23.00
2N5942	40.00
2N5944	9.20
2N5945	11.50
2N5946	19.00
2N6080	9.20
2N6081	10.35
2N6082	11.50
2N6083	$ 13.25
2N6084	15.00
2N6094 /M9622	11.00
2N6095 /M9623	12.00
2N6096 /M9624	15.50
2N6097	17.25
2N6136	21.85
2N6166	40.25
2N6201	50.00
2N6459	18.00
2N6603	12.00
2N6680	80.00
2SC756A	7.50
2SC781	2.80
2SC1018	1.00
2SC1042	12.00
2SC1070	2.50
2SC1239	2.50
2SC1251	12.00
2SC1306	2.90
2SC1307	5.50
2SC1760	1.50
2SC1970	2.50
2SC2166	5.50
8B1087 (M.A.)	25.00
A50-12	20.00
A283B	5.00
ALD4200N (AVANTEK)	395.00
AM123	97.35
AM688	100.00
BB105B	.52
BD4/4JFBD4 (G.E.)	10.00
BFQ85	1.50
BFR90	1.30
BFR91	1.65
BFW92	1.50
BFX89	1.00
BFY90	1.00
BGY54	25.00
BGY55	25.00
BGY74	25.00
BGY75	25.00
BL161	10.00
BLX67	11.00
BLY568CF	25.00
BLY87	13.00
BLY88	14.00
BLY89	15.00
BLY90	20.00
BLY351	10.00
C4005	20.00
CA402 (TRW)	25.00
CA405 (TRW)	25.00
CA612B (TRW)	25.00
CA2100 (TRW)	25.00
CA2113 (TRW)	25.00
CA2200 (TRW)	25.00
CA2213 (TRW)	25.00
CA2418 (TRW)	25.00
CA2612 (TRW)	$ 25.00
CA2674 (TRW)	25.00
CA2881-1(TRW)	25.00
CA4101 (TRW)	25.00
CA4201 (TRW)	25.00
CA4600 (TRW)	25.00
CD1889	20.00
CD2545	20.00
CMD514AB	20.00
D4959	10.00
D4987M	20.00
D5147D	10.00
D5506	10.00
D5827AM	20.00
DMD6022	30.00
DMS-2A-250	40.00
HEP76	4.95
HEPS3002	11.30
HEPS3003	30.00
HEPS3005	10.00
HEPS3006	19.90
HEPS3007	25.00
HEPS3010	11.34
HTEF2204 H.P.	112.00
5082-0112 H.P.	14.20
5082-0253 H.P.	105.00
5082-0320 H.P.	58.00
5082-0386 H.P.	POR
5082-0401 H.P.	POR
5082-0438 H.P.	POR
5082-1028 H.P.	POR
5082-2711 H.P.	23.15
5082-3080 H.P.	2.00
5082-3188 H.P.	1.00
5082-6459 H.P.	POR
5082-8323 H.P.	POR
35826E H.P.	POR
35831E H.P.	29.99
35853E H.P.	71.50
35854E H.P.	75.00
HPA0241 H.P.	75.60
HXTR3101 H.P.	7.00
HXTR3102 H.P.	8.75
HXTR6101/2N6617 H.P.	55.00
HXTR6104 H.P.	68.00
HXTR6105 H.P.	31.00
HXTR6106 H.P.	33.00
QSCH1995 H.P.	POR
JO2000 TRW	10.00
JO2001 TRW	25.00
JO4045 TRW	25.00
K3A	10.00
MA450A	10.00
MA41487	POR
MA41765	POR
MA43589	POR
MA43636	POR
MA47044	POR
MA47651	25.50

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GaAs, TUNNEL DIODES, ETC.

PART	PRICE
MA47100	$ 3.05
MA47202	30.80
MA47771	POR
MA47852	POR
MA49558	POR
MB4021	POR
MBD101	1.00
MDO513	POR
MHW1171	42.50
MHW1182	48.60
MHW4171	49.35
MHW4172	51.90
MHW4342	68.75
MLP102	25.00
MM1500	32.32
MM1550	POR
MM1552	50.00
MM1553	50.00
MM1614	10.00
MM2608	5.00
MM3375A	11.50
MM4429	10.00
MM8000	1.15
MM8006	2.30
MO277L	POR
MO283L	POR
MO3757	POR
MP102	POR
MPN3202	10.00
MPN3401	.52
MPN3412	1.00
MPSU31	1.01
MRA2023-1.5 TRW	42.50
MRF212/208	16.10
MRF223	13.25
MRF224	15.50
MRF237	3.15
MRF238	12.65
MRF243	25.00
MRF245	34.50
MRF247	34.50
MRF304	43.45
MRF315	23.00
MRF420	20.00
MRF421	36.80
MRF422	41.40
MRF427	16.10
MRF428	46.00
MRF450/A	13.80
MRF453/A	17.25
MRF454/A	19.90
MRF455/A	16.00
MRF458	19.90
MRF463	25.00
MRF472	1.00
MRF475	2.90
MRF477	11.50
MRF502	1.04

PART	PRICE
MRF503	$ 6.00
MRF504	7.00
MRF509	5.00
MRF511	8.65
MRF605	20.00
MRF629	3.47
MRF644	23.00
MRF816	15.00
MRF823	20.00
MRF901	3.00
MRF8004	2.10
MS261F	POR
MT4150 Fair.	POR
MT5126 Fair.	POR
MT5481 Fair.	POR
MT5482 Fair.	POR
MT5483 Fair.	POR
MT5596 Fair.	POR
MT5764 Fair.	POR
MT8762 Fair.	POR
MV109	.77
MV1401	8.75
MV1624	1.42
MV1805	15.00
MV1808	10.00
MV1817B	10.00
MV1863B	10.00
MV1864A	10.00
MV1864B	10.00
MV1864D	10.00
MV1868D	10.00
MV2101	.90
MV2111	.90
MV2115	1.55
MV2201	.53
MV2203	.53
MV2209	2.00
MV2215	2.00
MWA110	7.45
MWA120	7.80
MWA130	8.25
MWA210	7.80
MWA220	8.25
MWA230	8.65
MWA310	8.25
MWA320	8.65
MWA330	9.50
NEC57835	5.30
ON382	5.00
PPT515-20-3	POR
PRT8637	POR
PSCQ2-160	POR
PT3190	POR
PT3194	POR
PT3195	POR
PT3537	POR
PT4166E	POR
PT4176D	POR

PART	PRICE
PT4186B	$ POR
PT4209	POR
PT4209C	POR
PT4566	POR
PT4570	POR
PT4571	POR
PT4571A	POR
PT4577	POR
PT4590	POR
PT4612	POR
PT4628	POR
PT4640	POR
PT4642	POR
PT5632	POR
PT5749	POR
PT6612	POR
PT6626	POR
PT6709	POR
PT6720	POR
PT8510	POR
PT8524	POR
PT8609	POR
PT8633	POR
PT8639	POR
PT8659	POR
PT8679	POR
PT8708	POR
PT8709	POR
PT8727	POR
PT8731	POR
PT8742	POR
PT8787	POR
PT9790	41.70
PT31962	POR
PT31963	POR
PT31983	POR
PTX6680	POR
RAY-3	24.99
40081	POR
40281	POR
40282	POR
40290	POR
RF110	25.00
SCA3522	POR
SCA3523	POR
SD1065	POR
SS43	POR
TP1014	POR
TP1028	POR
TRW-3	POR
UTO504 Avantek	70.00
UTO511 Avantek	75.00
V15	4.00
V33B	4.00
V100B	4.00
VAB801EC	25.00
VAB804EC	25.00
VAS21AN20	25.00

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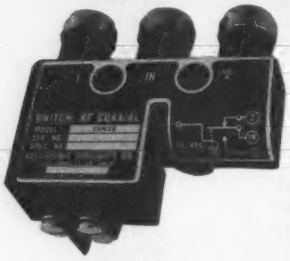
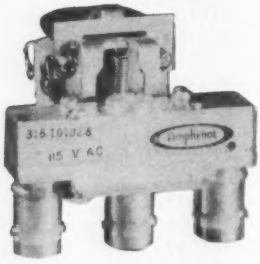
COAXIAL RELAY SWITCHES SPDT

Electronic Specialty Co./Raven Electronics FSN 5985-556-9683 $49.00
Part # 25N28 Part # SU-01
26Vdc Type N Connector, DC to 1 GHz.



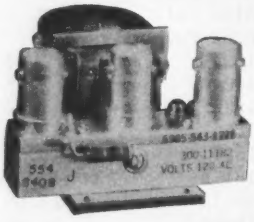
Amphenol
Part # 316-10102-8
115Vac Type BNC DC to 3 GHz.

$29.99



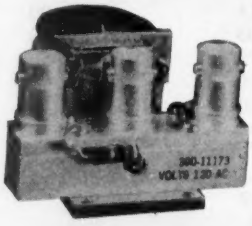
FXR
Part # 300-11182
120Vac Type BNC DC to 4 GHz.
FSN 5985-543-1225

$39.99



FXR
Part # 300-11173
120Vac Type BNC Same
FSN 5985-543-1850

$39.99



BNC To Banana Plug Coax Cable RG-58 36 inch or BNC to N Coax Cable RG-58 36 inch.

$7.99 or 2 For $13.99 or 10 For $50.00

$8.99 or 2 For $15.99 or 10 For $60.00

SOLID STATE RELAYS

P&B Model ECT1DB72 PRICE EACH $5.00	5vdc turn on	120vac contact at 7amps or 20amps on a 10"x 10"x .124 aluminum. Heatsink with silicon grease.
Digisig, Inc. Model ECS-215 PRICE EACH $7.50	5vdc turn on	240vac contact 14amps or 40amps on a 10"x 10"x .124 aluminum. Heatsink with silicon grease.
Grigsby/Barton Model GB7400 PRICE EACH $7.50	5vdc turn on	240vac contact at 15amps or 40amps on a 10"x 10"x .124 aluminum. Heatsink with silicon grease.

NOTE: *** Items may be substituted with other brands or equivalent model numbers. ***

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"MIXERS"

WATKINS JOHNSON WJ-M6 Double Balanced Mixer

LO and RF 0.2 to 300MHz	IF DC to 300MHz	$21.00
Conversion Loss (SSB)	6.5dB Max. 1 to 50MHz 8.5dB Max. .2 to 300MHz	WITH DATA SHEET
Noise Figure (SSB)	same as above 8.5dB Max. 50 to 300MHz	
Conversion Compression	.3dB Typ.	

NEC (NIPPON ELECTRIC CO. LTD. NE57835/2SC2150 Microwave Transistor

NF Min F=2GHz	dB 2.4 Typ.		MAG F=2GHz	dB 12 Typ.	$5.30
F=3GHz	dB 3.4 Typ.		F=3GHz	dB 9 Typ.	
F=4GHz	dB 4.3 Typ.		F=4GHz	dB 6.5 Typ.	

Ft Gain Bandwidth Product at Vce=8v, Ic=10ma. GHz 4 Min. 6 Typ.
Vcbo 25v Vceo 11v Vebo 3v Ic 50ma. Pt. 250mw

UNELCO RF Power and Linear Amplifier Capacitors

These are the famous capacitors used by all the RF Power and Linear Amplifier manufacturers, and described in the RF Data Book.

5pf	10pf	18pf	30pf	43pf	100pf	200pf	1 to 10pcs. $1.00 ea
5.1pf	12pf	22pf	32pf	51pf	110pf	220pf	11 to 50pcs. $ .90 ea
6.8pf	13pf	25pf	33pf	60pf	120pf	470pf	51 up pcs. $ .80 ea
7pf	14pf	27pf	34pf	80pf	130pf	500pf	
8.2pf	15pf	27.5pf	40pf	82pf	140pf	1000pf	

NIPPON ELECTRIC COMPANY TUNNEL DIODES $7.50

		MODEL 1S2199	1S2200
Peak Pt. Current ma.	Ip	9min. 10Typ. 11max.	9min. 10Typ. 11max.
Valley Pt. Current ma.	Iv	1.2Typ. 1.5max.	1.2Typ. 1.5max.
Peak Pt. Voltage mv.	Vp	95Typ. 120max.	75Typ. 90max.
Projected Peak Pt. Voltage mv.	Vpp Vf=Ip	480min. 550Typ. 630max.	440min. 520Typ. 600max.
Series Res. Ohms	rS	2.5Typ. 4max.	2Typ. 3max.
Terminal Cap. pf.	Ct	1.7Typ. 2max.	5Typ. 8max.
Valley Pt. Voltage mv.	VV	370Typ.	350Typ.

FAIRCHILD / DUMONT Oscilloscope Probes Model 4290B

Input Impedance 10 meg., Input Capacity 6.5 to 12pf., Division Ration (Volts/Div Factor) 10:1, Cable Length 4Ft. , Frequency Range Over 100MHz.
These Probes will work on all Tektronix, Hewlett Packard, and other Oscilloscopes.

PRICE $45.00

MOTOROLA RF DATA BOOK

List all Motorola RF Transistors / RF Power Amplifiers, Varactor Diodes and much much more.

PRICE $7.50

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"SOCKETS AND CHIMNEYS"

EIMAC TUBE SOCKETS AND CHIMNEYS

SK110	Socket	$POR
SK300A	Socket For 4CX5000A,R,J, 4CX10,000D, 4CX15,000A,J	$520.00
SK400	Socket For 4-125A,250A,400A,400C,4PR125A,400A,4-500A,5-500A	260.00
SK406	Chimney For 4-250A,400A,400C,4PR400A	74.00
SK416	Chimney For 3-400Z	36.00
SK500	Socket For 4-1000A/4PR1000A/B	390.00
SK600	Socket For 4CX250B,BC,FG,R,4CX350A,F,FJ	51.00
SK602	Socket For 4CX250B,BC,FG,R,4CX350A,F,FJ	73.00
SK606	Chimney For 4CX250B,BC,FG,R,4CX350A,F,FJ	11.00
SK607	Socket For 4CX600J,JA	60.00
SK610	Socket For 4CX600J,JA	60.00
SK620	Socket For 4CX600J,JA	66.00
SK626	Chimney For 4CX600J,JA	10.00
SK630	Socket For 4CX600J,JA	66.00
SK636B	Chimney For 4CX600J,JA	34.00
SK640	Socket For 4CX600J,JA	36.00
SK646	Chimney For 4CX600J,JA	71.00
SK700	Socket For 4CX300A,Y,4CX125C,F	225.00
SK711A	Socket For 4CX300A,Y,4CX125C,F	225.00
SK740	Socket For 4CX300A,Y,4CX125C,F	86.00
SK770	Socket For 4CX300A,Y,4CX125C,F	86.00
SK800A	Socket For 4CX1000A,4CX1500B	225.00
SK806	Chimney For 4CX1000A,4CX1500B	40.00
SK810	Socket For 4CX1000A,4CX1500B	225.00
SK900	Socket For 4X500A	300.00
SK906	Chimney For 4X500A	57.00
SK1420	Socket For 5CX3000A	650.00
SK1490	Socket For 4CV8000A	585.00

JOHNSON TUBE SOCKETS AND CHIMNEYS

124-111/SK606	Chimney For 4CX250B,BC,FG,R, 4CX350A,F,FJ	$ 10.00
122-0275-001	Socket For 3-500Z, 4-125A, 250A, 400A, 4-500A, 5-500A	(pair)15.00
124-0113-00	Capacitor Ring	15.00
124-116/SK630A	Socket For 4CX250B,BC,FG,R, /4CX350A,F,FJ	55.00
124-115-2/SK620A	Socket For 4CX250B,BC,FG,R, /4CX350A,F,FJ	55.00
	813 Tube Socket	20.00

TUBE CAPS (Plate)

HR1, 4	$11.00
HR2,3, 6 & 7	13.00
HR5, 8	14.00
HR9	17.00
HR10	20.00

CHIP CAPACITORS

.8pf	10pf	100pf*	430pf
1pf	12pf	110pf	470pf
1.1pf	15pf	120pf	510pf
1.4pf	18pf	130pf	560pf
1.5pf	20pf	150pf	620pf
1.8pf	22pf	160pf	680pf
2.2pf	24pf	180pf	820pf
2.7pf	27pf	200pf	1000pf/.001uf*
3.3pf	33pf	220pf*	1800pf/.0018uf
3.6pf	39pf	240pf	2700pf/.0027uf
3.9pf	47pf	270pf	10,000pf/.01uf
4.7pf	51pf	300pf	12,000pf/.012uf
5.6pf	56pf	330pf	15,000pf/.015uf
6.8pf	68pf	360pf	18,000pf/.018uf
8.2pf	82pf	390pf	

PRICES: 1 to 10 - .99¢ 101 to 1000 .60¢ * IS A SPECIAL PRICE: 10 for $7.50
11 to 50 - .90¢ 1001 & UP .35¢ 100 for $65.00
51 to 100 - .80¢ 1000 for $350.00

WATKINS JOHNSON WJ-V907: Voltage Controlled Microwave Oscillator $110.00

Frequency range 3.6 to 4.2GHz, Power ouput, Min. 10dBm typical, 8dBm Guaranteed. Spurious output suppression Harmonic (nf_0), min. 20dB typical, In-Band Non-Harmonic, min. 60dB typical, Residual FM, pk to pk, Max. 5KHz, pushing factor, Max. 8KHz/V, Pulling figure (1.5:1 VSWR), Max. 60MHz, Tuning voltage range +1 to +15volts, Tuning current, Max. -0.1mA, modulation sensitivity range, Max. 120 to 30MHz/V, Input capacitance, Max. 100pf, Oscillator Bias +15 +-0.05 volts @ 55mA, Max.

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TUBES

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
2E26	$ 5.69	KT88	$ 20.00	6562/6974A	$ 50.00
2K28	100.00	DX362	50.00	6832	22.00
2X1000A	300.00	DX415	50.00	6883/8032A/8552	7.00
3B22	19.75	572B/T160L	49.00	6897	110.00
3B28/866A	7.50	592/3-200A3	144.00	6907A	75.00
3-500Z	102.00	807	7.50	6939	15.00
3-1000Z	400.00	811	10.00	7094	125.00
3CX1000A/8283	428.00	811A	15.00	7117	17.00
3CX1500A7/887	533.00	812A	35.00	7211	60.00
3X2500A3	200.00	813	50.00	7289/3CX100A5	34.00
3CX3000A7	490.00	829B	38.00	7360	11.00
4-65A/8165	45.00	832A	28.00	7377	67.00
4-125A/4D21	58.00	4624	310.00	7408	4.00
4-250A/5D22	75.00	4662	80.00	7650	250.00
4-400A/8432	90.00	4665	585.00	7695	8.00
4-400C/6775	95.00	5675/A	25.00	7843	58.00
4-1000A/8166	300.00	5721	200.00	7854	83.00
4B32	22.00	5768	85.00	7868	5.00
4E27A/5-125B	155.00	5836	100.00	7894	12.00
4CS250R	146.00	5837	100.00	8072	65.00
4X150A/7034	30.00	5861/EC55	110.00	8117A	130.00
4X150D/7035	40.00	5876A	25.00	8121	60.00
4X150G/8172	100.00	5881/6L6W	6.00	8122	100.00
4X250B	30.00	5893	45.00	8236	30.00
4CX250B/7203	45.00	5894/A	50.00	8295/PL172	506.00
4CX250F/G/8621	55.00	5894/B	60.00	8462	100.00
4CX250K/8245	100.00	5946	258.00	8505A	73.50
4CX250R/7580W	69.00	6080	10.00	8533W	92.00
4CX300A/8167	140.00	6083/AX9909	89.00	8560/A	65.00
4CX350A/8321	83.00	6098/6AK6	14.00	8560AS	90.00
4CX350F/J/8904	95.00	6115/A	110.00	8608	34.00
4X500A	282.00	6146	7.00	8637	38.00
4CX600J/8809	607.00	6146A	7.50	8643	100.00
4CW800F	625.00	6146B/8298A	8.50	8647	123.00
4CX1000A/8168	340.00	6146W	14.00	8737/5894B	60.00
4CX1500B/8660	397.00	6156	66.00	8873	260.00
4CX5000A/8170	932.00	6159	15.00	8874	260.00
4CX10000D/8171	990.00	6161	233.00	8875	260.00
4CX15000A/8281	1260.00	6291	125.00	8877	533.00
4PR60A	100.00	6293	12.00	8908	12.00
4PR60B/8252	175.00	6360	5.00	8930/651Z	71.00
4PR400A/8188	192.00	6524	53.00	8950	12.00
5CX1500A	569.00	6550	10.00		
6BK4C	6.00	6JM6	6.00	6LQ6 (Sylvania)	7.50
6DQ5	5.00	6JN6	6.00	6LU8	6.00
6FW5	6.00	6JS6B	6.00	6LX6	6.00
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6JB5/6HE5	6.00	6LF6	6.00	6KD6	6.00
6JB6A	6.00	6LQ6 (GE)	6.00	6JT6A	6.00
				6KD6	6.00

NOTICE ALL PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE !!!!

"TVRO BOARD LIST"

70 MHZ IF BOARD: This circuit provides about 43dB gain with 50 ohm input and output impedance. It is designed to drive the Demodulator. The on-board bypass filter can be tuned to bandwidths between 20 and 35 MHz with a passband ripple of less than ½ dB. Hybrid IC's are used for the gain stages.

SINGLE AUDIO BOARD: This circuit recovers the audio signals from the 6.8 MHz frequency. The Miller 9051 coils are tuned to pass the 6.8MHz subcarrier and the 9052 coil tunes for recovery of the audio.

DUAL AUDIO BOARD: Duplicate of the single audio but also covers the 6.2 range.

DC CONTROL BOARD: No description.

DUAL AUDIO BOARD		PRICE EACH
Printed Circuit Board		$ 25.00
2	3pf sm	1.00
2	12pf sm	1.00
2	50pf sm	1.00
2	68pf sm	1.00
4	91pf sm	1.00
5	.001mfd	.35
6	.01mfd	.35
2	.047mfd	.35
1	.47mfd 25vdc	.35
2	1mfd 10vdc	.59
4	4.7mfd 35vdc	.59
1	470mfd 25vdc	1.29
2	220K 1/4w	.15
2	150K 1/4w	.15
2	6.8K 1/4w	.15
2	3.3K 1/4w	.15
2	2.2K 1/4w	.15
4	1K 1/4w	.15
2	10 ohm 1/4w	.15
2	50K pots	1.00
1	5K pot	1.00
2	CA3065	2.16
1	LM380	1.56
1	7812 Voltage Reg.	1.17
5	2N2222	.50
4	Miller 9051	5.99
2	Miller 9052	5.99
TOTAL KIT PRICE		97.62

DC CONTROL BOARD		
Printed Circuit Board		15.00
2	470mfd 25vdc	1.29
2	4.7mfd 25vdc	.59
1	1meg 1/4w	.15
3	10K 1/4w	.15
1	3.3K 1/4w	.15
3	2.2K 1/4w	.15
1	1K 1/4w	.15
2	5K 10 turn trimpot	1.00
4	10K 10 turn trimpot	1.00
1	10K 10 turn with dial	10.00
1	7815 Voltage Reg.	1.17
1	LM324	2.50
1	5 pole rotary switch	2.50
1	SPDT switch	1.00
1	DPDT swich	1.00
1	0-1ma meter	5.00
1	18 to 24vdc at 1 amp power supply	24.99
TOTAL KIT PRICE		74.27

DEMODULATOR BOARD		PRICE EACH
Printed Circuit Board		$ 40.00
1	1mfd 35vdc	.59
13	.01mfd 50vdc disc	.35
1	470mfd 25vdc	1.29
2	100mfd 16vdc	.69
2	22mfd 35vdc	.59
3	4.7mfd 35vdc	.59
1	4300pf sm	2.00
1	330pf sm	1.00
1	100pf sm	1.00
1	91pf sm	1.00
2	3pf sm	1.00
1	2 to 8pf ceramic trimmer	1.00
1	100uh choke	1.50
1	4.7uh choke	1.50
1	2.7uh choke	1.50
4	100K 1/4w	.15
1	51 ohm 1/4w	.15
1	27K 1/4w	.15
5	10K 1/4w	.15
1	8.2K 1/4w	.15
2	4.7K 1/4w	.15
1	2.2K 1/4w	.15
1	1.2K 1/4w	.15
3	1K 1/4w	.15
3	560 ohm 1/4w	.15
1	470 ohm 1/4w	.15
1	390 ohm 1/4w	.15
1	300 ohm 1/4w	.15
1	270 ohm 1/4w	.15
1	150 ohm 1/4w	.15
1	41 ohm 1/4w	.15
1	10K pot	1.00
1	NE592/LM733N	2.50
1	NE564	5.00
1	MWA120 (Motorola)	7.80
1	7812 Voltage Reg.	1.17
1	7815 Voltage Reg.	1.17
3	2N2222	.50
2	1N34/38	.50
1	HP5082-2800	2.20
1	5 to 7 volt Zenner	1.00
TOTAL KIT PRICE		92.25

COMPLETE KIT WITH DUAL AUDIO $923.23
COMPLETE KIT WITH SINGLE AUDIO 880.77

LESS 10% ON ALL COMPLETE KIT ORDERS

BOARDS AND PARTS MAY BE PURCHASED SEPERATELY AT THE PRICES LISTED ABOVE.

ALL PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

TVRO BOARD DESCRIPTION AND PARTS LIST

DUAL CONVERSION BOARD: This board provides conversion from the 3.7-4.2 band first to 900 MHz where gain and bandpass filtering are provided and, second, to 70 MHz. The board contains both local oscillators, one fixed and the other variable, and the second mixer. Construction is greatly simplified by the use of Hybrid IC amplifiers for the gain stages.

DEMODULATOR BOARD: This circuit takes the 70 MHz center frequency satellite TV signal in the 10 to 200 millivolt range, detects them using a phase lock loop, de-emphasizes and filters the result to produce standard NTSC video. Other outputs include the audio subcarrier, a DC voltage proportional to the strength of the 70 MHz signal, and AFC voltage centered at about 2 volts DC.

DUAL CONVERSION BOARD		PRICE EACH
Printed Circuit Board		$ 25.00
6	47pf chip caps	1.00
2	4.7mfd 35vdc	.59
2	.01mfd 50vdc disc cap	.35
4	1.5 to 8pf piston trimmer cap	5.99
2	470 ohm 1/4w	.15
2	MWA320 (Motorola)	8.65
1	7815 Voltage Reg.	1.17
1	VTO8090	150.00
1	VTO8240	156.25
2	1N4005	.39
1	DBM500/1100 (Varil)	125.00
1	MLP102 (Engleman)	25.00
8	SMA Male Connector	5.00
TOTAL KIT PRICE		572.64

70 MHZ IF BOARD	
Printed Circuit Board	25.00
3	MWA120	7.80
7	.01mfd 50vdc	.35
2	4.7mfd 35vdc	.59
1	10pf sm	1.00
5	22pf sm	1.00
1	18pf sm	1.00
1	33pf sm	1.00
2	330 ohm 1/4w	.15
5	J.W. Miller 4500-4	4.99
1	7815 Voltage Reg.	1.17
TOTAL KIT PRICE		86.45

SINGLE AUDIO BOARD		PRICE EACH
Printed Circuit Board		$ 15.00
1	3pf sm	1.00
1	12pf sm	1.00
1	50pf sm	1.00
1	68pf sm	1.00
2	91pf sm	1.00
3	.001mfd	.35
3	.01mfd	.35
1	.047mfd	.35
1	.47mfd	.35
1	1mfd 10vdc	.59
3	4.7mfd 35vdc	.59
1	470mfd 25vdc	1.29
1	220K 1/4w	.15
1	150K 1/4w	.15
1	6.8K 1/4w	.15
1	3.3K 1/4w	.15
1	2.2K 1/4w	.15
3	1K 1/4w	.15
1	10 ohm 1/4w	.15
1	50K pot	1.00
1	5K pot	1.00
1	CA3065/MC1358P	2.16
1	LM380	1.56
1	7812 Voltage Reg.	1.17
3	2N2222	.50
2	Miller 9051	5.99
1	Miller 9052	5.99
TOTAL KIT PRICE		55.16

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"CHIPS"

FAIRCHILD VHF AND UHF PRESCALER CHIPS		PRICE
95H90DC	350MC Prescaler divide by 10/11	$ 8.50
95H91DC	350MC Prescaler divide by 5/6	8.50
11C90DC	650MC Prescaler divide by 10/11	15.50
11C91DC	650MC Prescaler divide by 5/6	15.50
11C06DC	UHF Prescaler 750MC D Type Flip Flop	12.30
11C05DC	1GHz Counter Divide by 4 (Regular price $75.00)	50.00
11C01FC	High Speed Dual 5/4 Input NO/NOR Gate	15.40
82S90	Presettable High Speed Decade/Binary Counter used with the 11C90/91 or the 95H90/91 Prescaler can divide by 100. (Signetics)	5.00
11C24DC	This chip is the same as a Motorola MC4024/4324 Dual TTL Voltage Control Multivibrator.	3.37
11C44DC	This chip is the same as a Motorola MC4044/4344 Phase Frequency Detector.	3.37

GENERAL ELECTRIC CO. GUNN DIODE MODEL Y-2167
Freq. Gap (GHZ) 12 to 18, Output (Min.) 100mW, Duty (%) CW, Typ. Bias (Vdc) 8.0, Type. Oper. (MAdc) 550, Max. Thres. (mAdc) 1000, Max. Bias (Vdc) 10.0. **$39.99**

VARIAN GALLIUM ARSENIDE GUNN DIODES MODEL VSX-9201S5
Freq. Coverage 8 to 12.4GHz, Output (Min.) 100mW, Bias Voltage (Max.) 14vdc, Bias current (mAdc) Operating 550 Typ. 750 Max., Threshold 850 Tup. 1000 Max. **$39.99**

VARI-L Co. Inc. MODEL SS-43 AM MODULATOR
Freq. Range 60 10 150MC, Insertion Loss 13dB Nominal, Signal Port Imp. 50ohms Nominal, Signal Port RF Power + 10dBm Max., Modulation Port BW DC to 1KHZ, Modulation Port Bias 1ma. Nominal. **$24.99**

AVANTEK CASCADABLE MODULAR AMPLIFIERS	Model UTO-504	UTO-511
Frequency Range	5 to 500 MHz	5 to 500 MHz
Gain	6dB	15dB
Noise Figure	11dB	2.3dB to 3dB
Power Output	+ 17dB	– 2dB to – 3dB
Gain Flatness	1dB	1dB
Input Power Vdc	+ 24	+ 15
mA	100	10
PRICE	$70.00	$75.00

HEWLETT PACKARD MIXERS MODELS	10514A	10514B
Frequency Range	2MHz to 500MC	2MHz to 500MC
Input/Output Frequency L & R	200KHz to 500MC	200KHz to 500MC
X	DC to 500MC	DC to 500MC
Mixer Conversion Loss (A)	7dB	7dB
(B)	9dB	9dB
Noise Performance (SSB) (A)	7dB	7dB
(B)	9dB	9dB
PRICE	$49.99	$39.99

FREQUENCY SOURCES, INC MODEL MS-74X MICROWAVE SIGNAL SOURCE
MS-74X: Mechanically Tunable Frequency Range (MHz) 10630 to 11230 (10.63 to 11.23GHz) Minimum Output Power (mW) 10, Overall Multiplier Ratio 108, Internal Crystal Oscillator Frequency Range (MHz) 98.4 to 104.0, Maximum Input Current (mA) 400.

The signal source are designed for applications where high stability and low noise are of prime concern. these sources utilize fundamental transistor oscillators with high Q coaxial cavities, followed by broadband stable step recovery diode multipliers. This design allows single screw mechanical adjustment of frequency over standard communications bands. Broadband sampling circuits are used to phase lock the oscillator to a high stability reference which may be either an internal self-contained crystal oscillator, external primary standard or VHF synthesizer. This unique technique allows for optimization of both FM noise and long term stability. List Price is $1158.00 (THESE ARE NEW) **Our Price—$289.**

HEWLETT PACKARD 1N5712 MICROWAVE DIODE
This diode will replace the MBD101, 1N5711, 5082-2800, 5082-2835 ect. This will work like a champ in all those Down Converter projects. **$1.50 or 10/$10.00**

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Frequency Range: 40 to 300 MHz., Power Gain at 50MHz 16.6min. to 17.4max., Gain Flatness ±0.1 Typ. ±0.2 Max. dB., DC Supply Voltage – 28vdc, RF Voltage Input + 70dBmV **PRICE $29.99**

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DELIVERY: Orders are normally shipped within 48 hours after receipt of customer's order. If a part has to be backordered the customer is notified. Our normal shipping method is via First Class Mail or UPS depending on size and weight of the package. On test equipment it is by Air only, FOB shipping point.

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HOURS: Monday thru Saturday: 8:30 a.m. to 5:00 p.m.

INSURANCE: Please include 25¢ for each additional $100.00 over $100.00, United Parcel only.

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PREPAID ORDERS: Order must be accompanied by a check.

PRICES: Prices are subject to change without notice.

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FOREIGN: Prepaid only, U.S. Funds—money order or cashier's check only.

C.O.D.: Acceptable by telephone or mail. Payment from customer will be by cash, money order or cashier's check. We are sorry but we cannot accept personal checks for C.O.D.'s.

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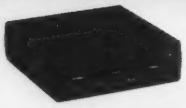


9 DIGITS 600 MHz $129.95 WIRED

PRICES

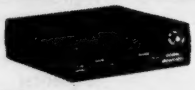
CT-90 wired, 1 year warranty	$129.95
CT-90 Kit, 90 day parts warranty	109.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC Adapter/Charger	12.95
OV-1, Micro-power Oven time base	49.95
External time base input	14.95

The CT-90 is the most versatile, feature packed counter available for less than $300.00! Advanced design features include; three selectable gate times, nine digits, gate indicator and a unique display hold function which holds the displayed count after the input signal is removed! Also, a 10mHz TCXO time base is used which enables easy zero beat calibration checks against WWV. Optionally; an internal nicad battery pack, external time base input and Micro-power high stability crystal oven time base are available. The CT-90, performance you can count on!

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 10 MV to 150 MHz Less than 50 MV to 500 MHz
Resolution:	0.1 Hz (10 MHz range) 1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	9 digits 0.4" LED
Time base:	Standard-10.000 mHz, 1.0 ppm 20-40°C. Optional Micro-power oven-0.1 ppm 20-40°C
Power:	8-15 VAC @ 250 ma

7 DIGITS 525 MHz $99.95 WIRED



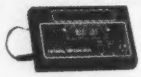
SPECIFICATIONS:

Range:	20 Hz to 525 MHz
Sensitivity:	Less than 50 MV to 150 MHz Less than 150 MV to 500 MHz
Resolution:	1.0 Hz (5 MHz range) 10.0 Hz (50 MHz range) 100.0 Hz (500 MHz range)
Display:	7 digits 0.4" LED
Time base:	1.0 ppm TCXO 20-40°C
Power:	12 VAC @ 250 ma

The CT-70 breaks the price barrier on lab quality frequency counters. Deluxe features such as; three frequency ranges - each with pre-amplification, dual selectable gate times, and gate activity indication make measurements a snap. The wide frequency range enables you to accurately measure signals from audio thru UHF with 1.0 ppm accuracy - that's .0001%! The CT-70 is the answer to all your measurement needs, in the field, lab or ham shack.

PRICES:

CT-70 wired, 1 year warranty	$99.95
CT-70 Kit, 90 day parts warranty	84.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC adapter/charger	12.95



7 DIGITS 500 MHz $79.95 WIRED

PRICES:

MINI-100 wired, 1 year warranty	$79.95
AC-Z Ac adapter for MINI-100	3.95
BP-Z Nicad pack and AC adapter/charger	12.95

Here's a handy, general purpose counter that provides most counter functions at an unbelievable price. The MINI-100 doesn't have the full frequency range or input impedance qualities found in higher price units, but for basic RF signal measurements, it can't be beat! Accurate measurements can be made from 1 MHz all the way up to 500 MHz with excellent sensitivity throughout the range, and the two gate times let you select the resolution desired. Add the nicad pack option and the MINI-100 makes an ideal addition to your tool box for "in-the-field" frequency checks and repairs.

SPECIFICATIONS:

Range:	1 MHz to 500 MHz
Sensitivity:	Less than 25 MV
Resolution:	100 Hz (slow gate) 1.0 KHz (fast gate)
Display:	7 digits, 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	5 VDC @ 200 ma

8 DIGITS 600 MHz $159.95 WIRED

NEW READ RECEIVER FREQUENCY

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 25 mv to 150 MHz Less than 150 mv to 600 MHz
Resolution:	1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	8 digits 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	110 VAC or 12 VDC

The CT-50 is a versatile lab bench counter that will measure up to 600 MHz with 8 digit precision. And, one of its best features is the Receive Frequency Adapter, which turns the CT-50 into a digital readout for any receiver. The adapter is easily programmed for any receiver and a simple connection to the receiver's VFO is all that is required for use. Adding the receiver adapter in no way limits the operation of the CT-50, the adapter can be conveniently switched on or off. The CT-50, a counter that can work double-duty!

PRICES:

CT-50 wired, 1 year warranty	$159.95
CT-50 Kit, 90 day parts warranty	119.95
RA-1, receiver adapter kit	14.95
RA-1 wired and pre-programmed (send copy of receiver schematic)	29.95

DIGITAL MULTIMETER $99.95 WIRED

PRICES:

DM-700 wired, 1 year warranty	$99.95
DM-700 Kit, 90 day parts warranty	79.95
AC-1, AC adaptor	3.95
BP-3, Nicad pack +AC adapter/charger	19.95
MP-1, Probe kit	2.95

The DM-700 offers professional quality performance at a hobbyist price. Features include; 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3½ digit, ½ inch LED readout with automatic decimal placement, automatic polarity, overrange indication and overload protection up to 1250 volts on all ranges, making it virtually goof-proof! The DM-700 looks great, a handsome, jet black, rugged ABS case with convenient retractable tilt bail makes it an ideal addition to any shop.

SPECIFICATIONS:

DC/AC volts:	100uV to 1 KV, 5 ranges
DC/AC current:	0.1uA to 2.0 Amps, 5 ranges
Resistance:	0.1 ohms to 20 Megohms, 6 ranges
Input impedance:	10 Megohms, DC/AC volts
Accuracy:	0.1% basic DC volts
Power:	4 'C' cells

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- Great for PL tones
- Multiplies by 10 or 100
- 0.01 Hz resolution!

$29.95 Kit $39.95 Wired

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Telescopic whip antenna - BNC plug	$ 7.95
High impedance probe, light loading	15.95
Low pass probe, for audio measurements	15.95
Direct probe, general purpose usage	12.95
Tilt bail, for CT 70, 90, MINI-100	3.95
Color burst calibration unit, calibrates counter against color TV signal	14.95

COUNTER PREAMP

For measuring extremely weak signals from 10 to 1,000 MHz. Small size, powered by plug transformer-included.

- Flat 25 db gain
- BNC Connectors
- Great for sniffing RF with pick-up loop

$34.95 Kit $44.95 Wired

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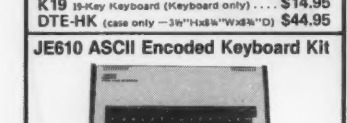
JE600/DTE-HK (After assembled as pictured above) **$99.95**

JE600 Kit 19-Key Hexadec. Keyboard, PC Board & Cmpnts. (no case) . . **$59.95**

K19 19-Key Keyboard (Keyboard only) **$14.95**

DTE-HK (case only —3⅛"H x 8¾"W x 8¾"D) **$44.95**

JE610 ASCII Encoded Keyboard Kit



The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10 mA for operation. Features: 60 keys generate the 128 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL, or MOS IC 'ic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector. Size: 3½"H x 14½"W x 8¾"D

JE610/DTE-AK (After assembled as pictured above) . . . **$124.95**

JE610 Kit 62-Key Keyboard, PC Board, & Components (no case) . . . **$ 79.95**

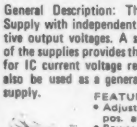
K62 62-Key Keyboard (Keyboard only) . . . **$ 34.95**

DTE-AK (case only — 3⅛"Hx11"Wx8¾"D) **$ 49.95**

NEW!! **JE212 — Negative 12VDC Adapter Board Kit for JE610 ASCII KEYBOARD KIT** Kit/ Provides -12VDC from incoming 5VDC . **$9.95**

JE215 Adjustable Dual Power Supply

General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.



FEATURES:
- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" indicator
- Printed Board Construction
- 120VAC input
- Size: 3-1/2"w x 5-1/16"L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) . . $24.95

(Picture not shown but similar in construction to above)
JE200 Reg. Power Supply Kit (5VDC, 1 amp) . . $14.95
JE205 Adapter Brd. (to JE200) ±5,±9 & ±12V . $12.95
JE210 Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp. . $19.95

HP-Display Sale-National

5082 Series — 0.43 Inch — 7-Segment

Part Number	Color	Description	1-3 Price	SALE PRICE
5082-7650	Hi Eff Red	CA - LHD	.99	4/$2.49
5082-7651	Hi Eff Red	CA - RHD	.99	4/$2.49
5082-7653	Hi Eff Red	CC - RHD	.99	4/$2.49
5082-7656	Hi Eff Red	Overflow ± 1RHD	.99	4/$2.49
5082-7660	Yellow	CA - LHD	.99	4/$2.49
5082-7661	Yellow	CA - RHD	.99	4/$2.49
5082-7663	Yellow	CC - RHD	.99	4/$2.49
5082-7670	Green	CA - LHD	.99	4/$2.49
5082-7671	Green	CA - RHD	.99	4/$2.49
5082-7673	Green	CC - RHD	.99	4/$2.49
5082-7676	Green	Overflow ± 1RHD	.99	4/$2.49
5082-7750	Red	CA - LHD	.99	4/$2.49
5082-7751	Red	CA - RHD	.99	4/$2.49
5082-7756	Red	Overflow ± 1RHD	.99	4/$2.49
5082-7760	Red	CC - RHD	.99	4/$2.49

CA-Comm. Anode CC-Comm. Cathode LHD/RHD-Left/right hand dec.

UTIC Mini Stereo AM/FM Receiver WITH HEADPHONES For Joggers, Cyclists, Skaters & Sports Events

CLOSE-OUT!

FEATURES: Lightweight headphones. Left/right balance control. Full fidelity stereo sound. Additional black soft carrying case & shoulder strap. Belt clip (hands free). Operates on 3 AA cell batteries (not incl.). Compact size: 3½" x 4¾" x 1". Wt. 6 oz.

Model 2830 . . . . . $29.95

KEYBOARDS — POWER SUPPLIES

9½"Lx4¼"Wx1"H

ALPS 26-KEY CALCULATOR KEYBOARD
Features: 7 Position, 3 Position and 2 Position Switches (ON/OFF). These are from Olivetti's Top of the Line. Mechanical SPST Switching: 22-pin Edge Card Connection.
Part No. KB26 . . . . . $1.95 each or 2/$3.49

18¾"L x 5¼"W x 1⅞"H

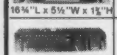
MICRO SWITCH 69-KEY KEYBOARD
Data Entry Keyboard, Encoded Output: 8-bit Parallel EBC DIC. Switching: Hall Effect, 24-pin Edge Card Connection. Complete with Pin Connection.
Part No. KB69SD12-2 (Fits into DTE-20 Enclosure) . . . . . $19.95 each

16¾"L x 5¼"W x 1⅞"H

DATANETICS 74-KEY KEYBOARD
ASCII Encoded Keyboard, Output: Even Parity ASCII. Supply voltage +5, -12 volt. Switching: Mechanical SPST — 50-pin Connection. Complete with Pin Connection.
Part No. KB354 (Fits into DTE-20 Enclosure) . . . . . $29.95 each

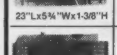
23"Lx5¾"Wx1-3/8"H

MICRO SWITCH 85-KEY KEYBOARD
Word Processing Keyboard, 26 Pin Edge Card Connection. Supply Voltage +5VDC. Main Keyboard is QWERTY. Additional Key Pads for Cursor and word processing functions.
Part No. 85SD18-1 . . . . . $29.95 each

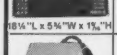


18¼"L x 5¾"W x 1⅝"H

MICRO SWITCH 88-KEY KEYBOARD (PARALLEL ASCII)
Data Entry Keyboard used in a Diablo 1640 Terminal. Supply Voltage: +5V, -12V. Switching: Hall Effect — 16-pin Edge Card Connection. Schematic included. Uses 8048 Encoder Chip.
Part No. 88SD22 (Fits into DTE-20 Enclosure) . . . . . $69.95 each

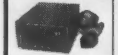


POWER SUPPLY — 5VDC @ 1 AMP REGULATED Transaction Tech
Output +5VDC @ 1 amp (also +30VDC) reg. Input 115VAC 60Hz. Two-tone (black/beige) self-enclosed case. 6 ft., 3 cond. black power cord. Size: 6⅛"W x 7"D x 2¾"H. Wt. 3 lbs.
Part No. PS51194 . . . . . $19.95 each



POWER SUPPLY — 5VDC @ 1 AMP REGULATED B Industries
Output +5VDC @ 1 amp, +30-42VDC adj. 400mA or less. 30VAC (isol.) @ 1.5 amp. Input 115VAC 60Hz. Circ. brkr. re-set button. Blk. self-encl. case w/4 rubber feet. 6 ft., 3 cond. blk. pwr. cord. On/off switch. 6⅜"W x 7⅝"D x 3-7/8"H - wt. 7 lbs.
Part No. PS407D . . . . . $24.95 each

POWER SUPPLY — 5VDC @ 7.5 AMP, 12VDC @ 1.5 AMP SWITCHING
Input: 115VAC, 50-60Hz @ 3 amp/230VAC, 50Hz @ 1.6 amp. Fan volt./power supply select switches (115/230VAC). Output: 5VDC @ 7.6 amp, 12VDC @ 1.6 amp. 8 ft. blk. pow. cord. 11½"W x 13⅛"D x 3¾"H. Wt. 6 lbs.
Part No. PS94VO . . . . . $49.95 each



POWER PAC — Heavy Duty Multi-Voltage Power Supply — 5VDC, 12VDC, 24VDC
Output: +5VDC @ 30A, +12VDC @ 2A, -12VDC @ 4A & +24VDC @ 3A. Input: 115VAC, 7A, 220VAC, 3.5A. Reg.: ± .15% line & load contrl. Ripple: 100mV peak to peak (3MV RMS). Overvolt. protect.: 5V, +12V, -12V. Overcur. protect. incl. 15¾"L x 6"H x 11-7/8"D. Wt. 40 lbs.
Part No. 28S-016 . . . . . $89.95 each

SOC 2-6 (Pictured)

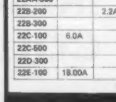
SORENSEN Regulated Power Supplies

Sorensen's open construction (SOC) power supplies are series-regulated solid-state systems, designed to provide reg. DC voltages at 6 levels (2-28 v/range). These units are open-framed on sturdy black anodized aluminum for excellent mounting.

FEATURES: 115/208/230VAC Input @ 50-63Hz. Low Ripple: 1.5mVrms, 5mV P-P maximum. Adjustable current limit. Voltage adjustment control. All schematics and specifications supplied with unit. Series A,B,C,E have three mounting surfaces (Series F, bottom mounting only).

Part No.	Series	Output Voltage Adjustment Range min.	max.	Output Current 50/60 (Hz) @40°C	@50°C	@60°C	Size (Inches)	Weight	Price
SOC 2-6	B	1.9	2.1	6.0	4.8	3.6	5.82 x 4.88 x 2.90	4.3 lbs.	$19.95
SOC 2-25	F	1.9	2.1	25.0	21.5	17.5	16.00 x 7.00 x 4.88	16 lbs.	39.95
SOC 5-3	A	4.75	5.25	3.0	2.4	1.2	4.00 x 4.88 x 1.62	2 lbs.	34.95
SOC 5-12	A	4.75	5.25	16.0	13.0	12.0	14.00 x 4.88 x 2.75	12 lbs.	59.95
SOC 5-25	F	4.75	5.25	25.0	21.5	17.5	16.00 x 4.88 x 4.88	16 lbs.	49.95
SOC 12-11	E	11.4	12.6	11.0	9.2	6.8	14.00 x 4.88 x 1.62	12 lbs.	44.95
SOC 12-15	E	11.4	12.6	15.0	12.75	9.5	16.00 x 4.88 x 4.88	16 lbs.	49.95
SOC15-6	C	14.25	15.75	6.0	4.2	3.6	7.00 x 4.88 x 3.37	6.6 lbs.	39.95
SOC 15-6.5	C	14.25	15.75	6.5	5.8	5.8	14.00 x 4.88 x 1.62	12. lbs.	44.95
SOC 15-12	F	14.25	15.75	13.0	10.5	10.5	16.00 x 4.88 x 4.88	16 lbs.	49.95
SOC 28-0.9	A	28.6	29.4	0.9	.84	.45	4.00 x 4.88 x 1.62	2 lbs.	34.95

Powertec Sub-Modular DC Power Supplies



22D300 (Pictured)

SM Series power supplies include rectifying, filtering, regulating, overload and overvoltage protection functions. You need only connect the sub-module to the appropriate secondary transformer tap and bolt the unit to a heatsink.

REGULATION: LINE: .10% for a change from -10% to +10% input voltage. LOAD: .15% for a 0-100% load change (units below 5V regulation 5V regulation). OUTPUT RIPPLE: 1mV RMS, 3mV P-P typical. 5mV P-P maximum. INPUT CHARACTERISTICS: Requires low-level AC input. Derate output current 15% for operations at 60Hz.

Part Number	−10% *4.75V to 7.0V	−20% *7.0V to 10.0V	−30% *10.0V to 15.75V	−50% *22.0V to 35.0V	Power Transformer Requirements (Transformers Not Included) Primary	Secondary	Size (Inches)	Wt.	Price
22AA-300			0.23A		115–120VAC	17VAC .5A no CT	2.50 x 3.00 x .98	2 oz.	$14.95
22B-200		2.2A			115–120VAC	22VAC .3A w/CT	3.00 x 5.75 x 1.18	8 oz.	14.95
22B-300			1.7A		115–120VAC	28VAC 2.5A w/CT	2.76 x 6.75 x 1.18	8 oz.	19.95
22C-100	6.0A				115–120VAC	16VAC 8A w/CT	2.80 x 7.50 x 1.18	8 oz.	24.95
22C-500				2.5A	115–120VAC	48VAC 3A w/CT	2.80 x 7.50 x 1.18	8 oz.	24.95
22D-300			6.8A		115–120VAC	28VAC 10A w/CT	3.00 x 7.00 x 3.30	2 lbs.	24.95
22E-100	18.00A				115–120VAC	16VAC 24A w/CT	2.80 x 7.00 x 3.30	2 lbs.	29.95

*Voltage Adjustment Range — Current ratings apply over entire voltage range.

★ SHIPMENT IN 24 HOURS ★

MONDAY-THRU-FRIDAY

7:00AM to 5:00PM (PST)

Call: (415) 592-8097

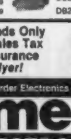
NEW HOURS

JUMPER AND CABLE ASSEMBLIES

Custom Jumpers!

STANDARD DIP JUMPERS

All jumpers use low profile dip plugs with heavy duty pins for repeated disconnect applications.



JAMECO Part No.	AP Cross Reference	No. Pins	Description	Wire Length	Price
DJ16-1	9241022-12	16	single end	12"	$1.79
DJ14-2	9241022-24	14	single end	24"	2.05
DJ16-3	9241022-36	16	single end	36"	2.30
DJ16-1-14	9241061-12	16	double end	12"	3.89
DJ16-2-16	9241061-24	16	double end	24"	3.49
DJ16-3-16	9241061-36	16	double end	36"	3.79
DJ16-1	9241112-12	16	single end	12"	1.89
DJ16-2	9241112-24	16	single end	24"	2.19
DJ16-3	9241112-36	16	single end	36"	2.89
DJ16-1-16	9241116-12	16	double end	12"	3.39
DJ16-2-16	9241116-24	16	double end	24"	3.69
DJ16-3-16	9241116-36	16	double end	36"	4.05
DJ24-1	9241222-12	24	single end	12"	2.69
DJ24-2	9241222-24	24	single end	24"	3.39
DJ24-3	9241222-36	24	single end	36"	3.95
DJ24-1-24	9241226-12	24	double end	12"	4.79
DJ24-2-24	9241226-24	24	double end	24"	5.29
DJ24-3-24	9241226-36	24	double end	36"	5.89

Custom Cables!

STANDARD DB25 SERIES CABLES

Now you can order DB25 P or S connectors with the cable necessary to fit your application. Choose from our standard flat cable in 4-foot lengths. Call today.

STANDARD CABLES

Part No.	Cable Length	Connectors	Price
DB25P-4	4 feet	1-DB25P	$ 9.95 ea.
DB25S-4	4 feet	1-DB25S	10.95 ea.
DB25P-4-P	4 feet	2-DB25P	16.95 ea.
DB25P-4-S	4 feet	1-DB25P/1-DB25S	17.95 ea.
DB25S-4-S	4 feet	2-DB25S	18.95 ea.

$10.00 Minimum Order — U.S. Funds Only
California Residents Add 6½% Sales Tax
Postage — Add 5% plus $1.50 Insurance
Send S.A.S.E. for Monthly Sales Flyer!

Spec Sheets — 30¢ each
Send $1.00 Postage for your
FREE 1983 JAMECO CATALOG
Prices Subject to Change

Call for Quantity Discounts

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PHONE ORDERS WELCOME — (415) 592-8097

10/82

5¼" Mini-Floppy Disc Drive

FOR TRS-80 MODEL I, III (Industry Standard)

Perfec Computer Corp.

Features single or double density. Recording mode: FM single, MFM double density. Power: +12VDC (±0.6V) 1.6 amps max., +5VDC (±0.25V) 0.8 amps max. Unit as pictured at left (does not incl. case, power supply or cables). 30-page data book included. Weighs 3½ pounds. Size: 5¾"W x 8"D x 3¼"H

Part No.	*Limited Quantity!*	Price
FD200	Single-sided, 40 tracks, 250K bytes capacity	$179.95
FD250	Double-sided, 35 tracks, 438K bytes capacity	$199.95

EXPAND YOUR TRS-80

to 16K, 32K, or 48K

**Model 1 = From 4K to 16K Requires (1) One KR
Model 3 = From 4K to 48K Requires (3) Three KRs
Color = From 4K to 16K Requires (1) One KR**

**Model 1 equipped with Expansion Board up to 48K Two KRs Required — One KR Required for each 16K of Expansion —

TRS-80 16K Conversion Kit

Kit comes complete with 8 each MM5290 (UPD416/4116) 16K Dynamic RAM (*ns) and documentation for conversion.

TRS-16K2 *150ns $16.95
TRS-16K3 *200ns $14.95
TRS-16K4 *250ns $10.95

TRS-80 Color 32K Conversion Kit

Kit comes complete with 8 ea. 4164-2 (200ns). 64K Dyn. RAMs & conversion documentation. Converts TRS-80 color computers with E-Revision Boards from 16K to 32K.

TRS-64K2 (200ns) $69.95

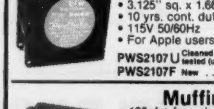
Universal Computer Keyboard Enclosure

3.40 9.50 (16" cable shown)

"DTE" Blank Desk-Top Enclosures are designed for easy modification. High strength epoxy molded and pieces in mocha brown finish. Sliding rear/bottom panel for service/component access. Top/bott. panels .080" thick alum. aladine type 1200 finish (gold tint color) for best paint adhesion after modification. Vented top & bottom panels for cooling efficiency.

DTE-20 Panel width 20" $39.95

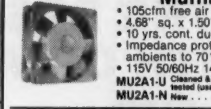
Pee Wee Boxer Fan



- 36cfm free air delivery
- 3.125" sq. x 1.665" depth
- 10 yrs. cont. duty at 20°C
- 115V 50/60Hz
- For Apple users

PWS2107 U Cleaned & tested (used) . . . **$ 7.95 ea.**
PWS2107F New . . . . . **$12.95 ea.**

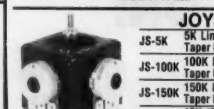
Muffin® Fan



- 105cfm free air delivery
- 4.68" sq. x 1.50" depth.
- 10 yrs. cont. duty at 20°C
- Impedance protected, ambients to 70°C
- 115V 50/60Hz 14W Wt. 17 oz.

MU2A1-U Cleaned & tested (used) . . . **$ 7.95 ea.**
MU2A1-N New . . . . . **$12.95 ea.**

JOYSTICKS

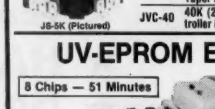


JS-5K (Pictured)

JS-5K	5K Linear Taper Pots	$5.25
JS-100K	100K Linear Taper Pots	$4.95
JS-150K	150K Linear Taper Pots	$4.75
JVC-40	40K (2) Video Controller in Case	$4.95

UV-EPROM Eraser

8 Chips — 51 Minutes



1 Chip — 37 Minutes

Erases 2708, 2716, 2732, 2764, 2516, 2532, 2564. Erases up to 8 chips within 51 minutes (1 chip in 37 minutes). Maintains constant exposure distance of one inch. Special conductive foam liner eliminates static build-up. Built-in safety lock to prevent UV exposure. Compact — only 9.00" x 3.70" x 2.80". Complete with holding tray for 8 chips.

UVS-11EL Replacement Bulb $16.95

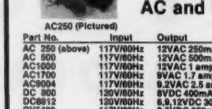
DE-4 UV-EPROM Eraser $79.95

Wall Transformers AC and DC Types

AC250 (Pictured)

Part No.	Input	Output	Price
AC 250 (above)	117V/60Hz	12VAC 250mA	$3.95
AC 500	117V/60Hz	12VAC 500mA	$4.95
AC1000	117V/60Hz	12VAC 1 amp	$5.95
AC1700	117V/60Hz	9VAC 1.7 amp	$3.95
AC9004	117V/60Hz	9.2VAC 2.5 amp	$2.95 or 2/$4.95
DC 900	120V/60Hz	9VDC 400mA	$1.95 or 2/$2.95
DC8912	120V/60Hz	8.9,12VDC 300mA	$9.95
DV5490	117V/60Hz	9.5VDC 275mA	$2.49 or 2/$3.95
DC909	120V/60Hz	9VDC 500mA	$3.95
DC1200	120V/60Hz	12VDC 300mA	$2.95 or 2/$4.95

MOTOROLA AM/FM Stereo Push Button Car Radio



FOR VOLKSWAGEN SCIROCCO, RABBIT, AUDI 5000 AND FOX (with minor adjustments, can be used in any automobile)

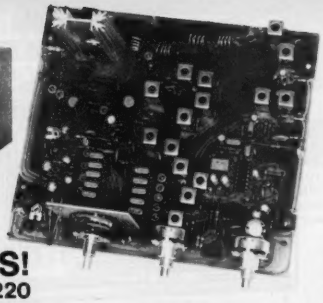
Includes bezel trim & everything pictured. Two ea. 4x6 speakers & grille (1½" deep). All cables & leads for hook-up. Incl. all instruction Manuals for easy installation. Cut-out dim.: 7"W x 1¾"H x 6½"L.

Model 5VW3901 . . . . . $49.95

• FM • SSB • CW • ATV • OSCAR
• LINKS • REPEATERS • TRANSMITTERS
• RECEIVERS • PREAMPS • CONVERTERS
• TRANSCEIVERS • POWER SUPPLIES • PA'S

QUALITY VHF/UHF KITS AT AFFORDABLE PRICES

NEW



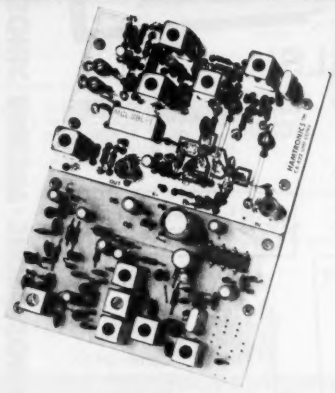
FM-5 PC Board Kit – **ONLY $159.95** complete with controls, heatsink, etc.

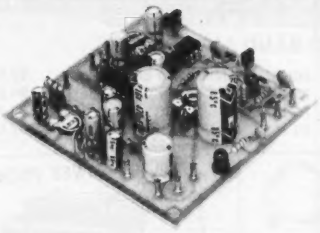
SPECIAL OFFER Free cabinet kit, complete with speaker, knobs, connectors, hardware. A $59.95 value, yours free with purchase of kit. Hurry! Offer limited.

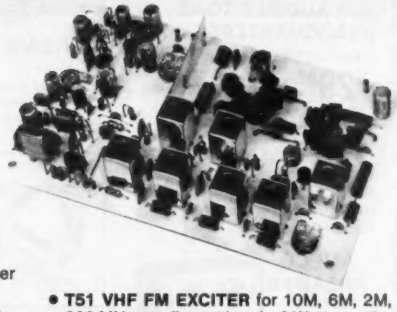
SAVE A BUNDLE ON VHF FM TRANSCEIVERS!

10 watts, 5 Channels, for 6M, 2M, or 220

HIGH QUALITY FM MODULES FOR REPEATERS, LINKS, TELEMETRY, ETC.







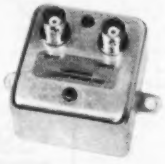
- **R76 VHF FM RECEIVER** for 10M, 6M, 2M, 220, or commercial bands. Fantastic selectivity options. Kits from $84.95 to $109.95
- **R450 UHF FM RECEIVER** for 380-520 MHz bands. Kits in selectivity options from $94.95
- **R110 VHF AM RECEIVER** Kit for vhf aircraft band or ham bands. Only $84.95.
- **COR KITS** With audio mixer and speaker amplifier. Only $29.95.
- **CWID KITS** 158 bits, field programmable, clean audio. Only $59.95.
- **A16 RF TIGHT BOX** Deep drawn alum. case with tight cover and no seams. 7 x 8 x 2 inches. Only $18.00.
- **SCANNER CONVERTERS** Copy 72-76, 135-144, 240-270, 400-420, or 806-894 MHz bands on any scanner. Wired/tested Only $79.95.
- **T51 VHF FM EXCITER** for 10M, 6M, 2M, 220 MHz or adjacent bands. 2 Watts continuous. Kits only $54.95.
- **T451 UHF FM EXCITER** 2 to 3 Watts on 450 ham band or adjacent. Kits only $64.95.
- **VHF & UHF LINEAR AMPLIFIERS.** Use on either FM or SSB. Power levels from 10 to 45 Watts to go with exciters & xmtg converters. Kits from $69.95.

VHF & UHF TRANSMITTING CONVERTERS

For SSB, CW, ATV, FM, etc. Available for 6M, 2M, 220, 440 with many IF input ranges. Converter board kit only at $79.95 (VHF) or $99.95 (UHF) or kits complete with PA and cabinet as shown.

VHF & UHF RECEIVING CONVERTERS

20 Models cover every practical rf and if range to listen to SSB, FM, ATV, etc. on 6M, 2M, 220, 440, and 110 aircraft band. Even convert weather down to 2M! Kits from $39.95 and wired units.



VHF & UHF RECEIVER PREAMPS. Low noise.

VHF Kits from 27 to 300 MHz. UHF Kits from 300 to 650 MHz. Broadband Kits: 20-650 MHz. Prices start at $14.95 (VHF) and $18.95 (UHF). All preamps and converters have noise figure 2dB or less.

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Micro-Computer Controlled Tuning!

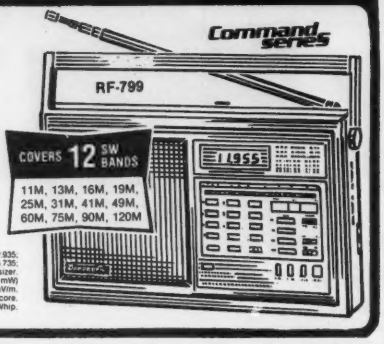
SPECTRONICS SHORTWAVE PORTABLE SPECIAL!

FM/AM/SW/LW 4-Band Portable with PLL Tuning

LIST ~~$249.95~~

NOW ONLY **$217.50**

- Micro-computer controlled PLL synthesized digital tuner "locks" onto stations
- LCD quartz clock/frequency readout



10 channel pre-set tuning for pushbutton recall. Battery back-up system for pre-set stations and clock. 10-key direct access tuning. Up-down manual tuning with fast button. Dial/clock light. LED tuning indicator. 3½" PM dynamic speaker. Tuning lock button. Dual voltage (100 127/220 240V, 50/60 Hz). Operates on 4 "C" batteries (not included) and 2 "AA" batteries for memory back-up (not included).

SPECIFICATIONS

Frequency Range (FM) 87.5-108 MHz; **(AM)** 530 - 1610 kHz; **(LW)** 153-281 kHz; **(SW-MHz)** 2.3-2.935, 2.4-3.575, 3.58-4.215, 4.54-5.175, 5.82-6.455, 7.1-7.735, 9.5-10.135, 11.58-12.215, 15.1-15.735, 17.5-18.135, 21.34-21.975, 25.5-26.135. **SW Type** - Single Superheterodyne with PLL Synthesizer. **Antenna:** Whip, Ext. ant. 75 ohm. **IF Freq.** 450 kHz. **Sensitivity** (400 MHz, 30% Modulation 50 mW) S/N 10 dB: 3uV/m, S/N 20 dB: 10uV/m. **AM/IF Freq.** 450 kHz. **Sens.** Max: 60uV/m 2in 20dB: 250uV/m. **Ant.** Ferrite core. **LW IF Freq.** 450 kHz. **Sens.** Max. 60uV/m: S/N 20dB: 300uV/m. **Ant.** Ferrite core. **FM/IF** Freq. 10.7 MHz. **Sens.** 4.5uV/75 ohm (-3dB, Limit Sens.) 60uV/75 ohm (S/N 20dB) Ant. Whip. Dim. (HWD) 6-9/16x10-15/16x2-5/16". Weight (Less Batteries) 3 lb 7 oz.

TALKMAN™ 2-WAY COMMUNICATIONS SET

$89.95 Ea plus $3.00 shipping (Cont'l USA)

- VOX for total hands-free operation
- 1/4-Mile range
- No license required

POPULAR HAMFEST SPECIALS!

SUB-AUDIBLE TONE HEADQUARTERS

ENCODERS **$29.95** EACH plus $2.00 shipping (Cont'l USA only)

We stock **Communications Specialists** SS-32 and SS-32M encoders for most any mobile or hand-held applications including the very popular **Icom Handhelds.**

AMECO PREAMPS

add $3.00 shipping (Cont'l USA only)

Model PLF-2..... $52.95
Model PLF-2E (240V)..... $57.95
Model PT-2..... $79.95
Model PT-2E (240V)..... $84.95

MORGAIN MULTI-BAND ANTENNAS

Add $5.00 for shipping (Cont'l U.S.A.)

80-40HD/A 80/40 Mtr bands (69)..... 99.00
75/40HD/A 75/40 Mtr bands (66)..... 94.50
75-10HD/A 75/40/20/15/10 Mtr (66)... 126.95
80-10HD/A 80/40/20/15/10 Mtr (69)... 132.00

FAMOUS "EAVESDROPPER" SW RECEIVING ANTENNA

$59.95 plus $3.00 shipping (Cont'l U.S.)

VoCom POWER POCKET

plus $8.00 shipping (Cont'l USA) **$199.95**

Accepts any version of the IC-2A, applies its output to a wide-band rf amplifier, and delivers 25 watts to your mobile antenna. Mobile talk-out power!

ICOM IC25A

NEW! IC3AT (220 MHz) IC4AT (440 MHz)

ICOM IC2A, IC2AT

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- Quality Construction
- Versatile
- Affordable
- Wide Range of Accessories Available

CALL FOR PRICE & AVAILABILITY

B&W PORTABLE SHORTWAVE ANTENNA

Simple, dependable whip is designed especially for apartment dwellers and renters who cannot install a permanent antenna. Tunes the 2, 6, 10, 15, 20 and 40-meter Amateur bands. Offers VSWR of 1.1:1 when properly adjusted to operating frequency. Ideal for use as a portable emergency antenna, too. Amounts to almost any horizontal support with a simple clamp bracket.

Weighs less than 2 pounds including five base-loading coils (not used for 6/2 meters), coax line and counterpoise. Whip is 22½" long disassembled, extends to 57". Mount is 14" long. Power rating: 360 watts SSB or CW.

Model 370-10..... $39.95

AVANTI THRU-GLASS ANTENNA

$32.95 plus $3.00 shipping

The Avanti On-Glass is the first two-way communications antenna that mounts on glass and transmits and receives through the glass. Extremely low VSWR is acheived by adjusting special tuning slug on matching network inside the vehicle. Can be easily removed for car washes without special tools.

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TERMS: Satisfaction guaranteed or money refunded. C.O.D. add $2.00. Minimum order $6.00. Orders under $10.00 add $1.50. Add 5% for postage, insurance, handling. Overseas add 15%. N.Y. residents add 7% tax.

MINI KITS - YOU HAVE SEEN THESE BEFORE NOW HERE ARE OLD FAVORITE AND NEW ONES TOO. GREAT FOR THAT AFTERNOON HOBBY.

FM MINI MIKE

A super high performance FM wireless mike kit! Transmits a stable signal up to 300 yards with exceptional audio quality by means of its built in electret mike. Kit includes case, mike, on-off switch, antenna, battery and super instructions. This is the finest unit available.

FM-3 Kit **$14.95**
FM-3 Wired and Tested **19.95**

Color Organ

See music come alive! 3 different lights flicker with music. One light each for, high, mid-range and lows. Each individually adjustable and drives up to 300 W. runs on 110 VAC.

Complete kit, ML-1 **$8.95**

Video Modulator Kit

Converts any TV to video monitor. Super stable, tunable over ch. 4-6. Runs on 5-15V, accepts std. video signal. Best unit on the market! Complete kit, VD-1 **$7.95**

Led Blinky Kit

A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons, warning panel lights, anything! Runs on 3 to 15 volts. Complete kit, BL-1 **$2.95**

Super Sleuth

A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2 W rms output, runs on 6 to 15 volts, uses 8-45 ohm speaker. Complete kit, BN-9 **$5.95**

CPO-1

Runs on 3-12 Vdc 1 wall out, 1 KHZ good for CPO, Alarm, Audio Oscillator. Complete kit **$2.95**

FM Wireless Mike Kit

Transmits up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Type FM-2 has added sensitive mike preamp stage.

FM-1 kit **$3.95** FM-2 kit **$4.95**

Whisper Light Kit

An interesting kit, small mike picks up sounds and converts them to light. The louder the sound, the brighter the light. Includes mike, controls up to 300 W, runs on 110 VAC. Complete kit, WL-1 **$6.95**

Tone Decoder

A complete tone decoder on a single PC board. Features: 400-5000 Hz adjustable range via 20 turn pot, voltage regulation, 567 IC. Useful for touch-tone burst detection, FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts. Complete kit, TD-1 **$5.95**

Universal Timer Kit

Provides the basic parts and PC board required to provide a source of precision timing and pulse generation. Uses 555 timer IC and includes a range of parts for most timing needs.

UT-5 Kit **$5.95**

Mad Blaster Kit

Produces LOUD ear shattering and attention getting siren like sound. Can supply up to 15 watts of obnoxious audio. Runs on 6-15 VDC

MB-1 Kit **$4.95**

Siren Kit

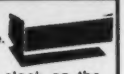
Produces upward and downward wail characteristic of a police siren. 5 W peak audio output, runs on 3-15 volts, uses 3-45 ohm speaker. Complete kit, SM-3 **$2.95**

60 Hz Time Base

Runs on 5-15 VDC. Low current (2.5ma). 1 min/month accuracy. TB-7 Kit **$5.50**
TB-7 Assy **$9.95**

CLOCK KITS

Your old favorites are here again. Over 7,000 Sold to Date. Be one of the gang and order yours today!



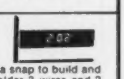
Try your hand at building the finest looking clock on the market. Its satin finish anodized aluminum case looks great anywhere, while six .4" LED digits provide a highly readable display. This is a complete kit, no extras needed, and it only takes 1-2 hours to assemble. Your choice of case colors: silver, gold, black (specify).

Clock kit, 12/24 hour, DC-5 **$24.95**
Clock with 10 min. ID timer, 12/24 hour, DC-10 **$29.95**
Alarm clock, 12 hour only, DC-8 **$29.95**
12V DC car clock, DC-7 **$29.95**

For wired and tested clocks add $10.00 to kit price.
SPECIFY 12 OR 24 HOUR FORMAT

Car Clock

The UN-KIT, only 5 solder connections



Here's a super looking, rugged and accurate auto clock, which is a snap to build and install. Clock movement is completely assembled — you only solder 3 wires and 2 switches, takes about 15 minutes! Display is bright green with automatic brightness control photocell — assures you of a highly readable display, day or night. Comes in a satin finish anodized aluminum case which can be attached 5 different ways using 2 sided tape. Choice of silver, black or gold case (specify)

DC-3 kit, 12 hour format **$22.95**
DC-3 wired and tested **$29.95**

Calendar Alarm Clock

The clock that's got it all: 6- 5" LEDs, 12/24 hour, snooze, 24 hour alarm, 4 year calendar, battery backup, and lots more. The super 7001 chip is used. Size: 5x4x2 inches. Complete kit, less case (not available) DC-9 **$34.95**

Under Dash Car Clock

12/24 hour clock in a beautiful plastic case features 6 jumbo RED LEDS, high accuracy (.001%), easy 3 wire hookup, display blanks with ignition, and super instructions. Optional dimmer automatically adjusts display to ambient light level

DC-11 clock with mtg. bracket **$27.95 kit**
DM-1 dimmer adapter **$2.50**
Add $10.00 Assy. and Test

Video Terminal

A completely self-contained, stand alone video terminal card. Requires only an ASCII keyboard and TV set to become a complete terminal unit. Features are: single 5V supply, XTAL controlled sync and baud rates (to 9600), complete computer and keyboard control of cursor. Parity error control and display. Accepts and generates serial ASCII plus parallel keyboard input. The 6416 is 64 char. by 16 lines with scrolling, upper and lower case (optional) and has RS-232 and 20ma loop interfaces on board. Kits include sockets and complete documentation

RE 6416, terminal card kit (add $60.00 for wired unit) **$189.95**
Lower Case option **$13.95**
Power Supply **$14.95**
RF Modulator kit **$7.95**

PARTS PARADE

IC SPECIALS

LINEAR

301	$ .35
324	$1.50
380	$1.50
555	$ .45
556	$1.00
565	$1.00
566	$1.00
567	$1.25
741	10/$2.00
1458	$ .50
3900	$ .50
3914	$2.95
8038	$2.95

CMOS

4011	.50
4013	.50
4046	$1.85
4049	.50
4059	$9.00
4511	$2.00
4518	$1.35
5639	$1.75

TTL

74S00	$ .40
7447	$ .65
7475	$ .50
7490	$ .50
74196	$1.35

SPECIAL

11C90	$15.00
10116	$ 1.25
7208	$17.50
7207A	$ 5.50
7216D	$21.00
7107C	$12.50
5314	$ 2.95
5375AB/G	$ 2.95
7001	$ 6.50

FERRITE BEADS

With info and specs **15/$1.00**
6 Hole Balun Beads **5/$1.00**

READOUTS

FND 359 .4" C.C.	$1.00
FND 507/510 .5" C.A.	1.00
MAN 72/HP7730 .33" C.A.	1.00
HP 7881 .43" C.A.	2.00

TRANSISTORS

2N3904 NPN C+F	15/$1.00
2N3906 PNP C+F	15/$1.00
2N4403 PNP C+F	15/$1.00
2N4410 NPN C+F	15/$1.00
2N4916 FET C+F	4/$1.00
2N5401 PNP C+F	5/$1.00
2N6026 C+F	4/$1.00
2N3771 NPN Silicon	$1.50
2N5179 UHF NPN	3/$2.00
Power Tab NPN 40W	3/$1.00
Power Tab PNP 40W	3/1.00
MPF 102/2N5484	$.50
NPN 3904 Type T+R	50/$2.50
PNP 3906 Type T+R	50/$2.50
2N3055	$.60
2N2646 UJT	3/$2.00

Sockets

8 Pin	10/$2.00
14 Pin	10/$2.00
16 Pin	10/$2.00
24 Pin	4/$2.00
28 Pin	4/$2.00
40 Pin	3/$2.00

Diodes

5.1 V Zener	20/$1.00
1N914 Type	50/$1.00
1KV 2Amp	8/$1.00
100V 1Amp	15/$1.00

25 AMP 100V Bridge **$1.50 each**

Mini-Bridge 50V 1 AMP 2 for $1.00

Resistor Ass't

Assortment of Popular values - ¼ watt. Cut lead for PC mounting, ½" center, ½" leads, bag of 300 or more. **$1.50**

Switches

Mini toggle SPDT **$1.00**
Red Pushbuttons N.O. **3/$1.00**

Earphones

3" leads, 8 ohm, good for small tone speakers, alarm clocks, etc. 5 for $1.00

Mini 8 ohm Speaker

Approx. 2¼" diam. Round type for radios, mike etc. **3 for $2.00**

Solid State Buzzers

small buzzer 450 Hz, 86 dB, sound output on 5-12 vdc at 10-30 mA, TTL compatible **$1.50**

Slug Tuned Coils

Small 3/16" Hex Slugs turned coil. 3 turns. 10 for $1.00

AC Outlet

Panel Mount with Leads **4/$1.00**

CAPACITORS

TANTALUM Dipped Epoxy		ALUMINUM Electrolytic		DISK CERAMIC	
1.5 uF 25V 3/$1.00		1000 uF 16V Radial	$.50	01 16V disk	20/$1.00
1.8 uF 25V 3/$1.00		500 uF 20V Axial	$.50	001 16V	15/$1.00
.22 uF 25V 3/$1.00		150 uF 16V Axial	5/$1.00	100 pF	20/$1.00
		10 uF 15V Radial	10/$1.00	047 16V	20/$1.00

DC-DC Converter

+5 vdc input prod. -9 vdc @ 30ma
+9 vdc produces -15 vdc @ 35ma **$1.25**

Ceramic IF Filters

Mini ceramic filters 7 kHz B.W. 455 kHz $1.50 ea.

25K 20 Turn Trim Pot **$1.00**
1K 20 Turn Trim Pot **.50**

Trimmer Caps

Sprague - 3-40 pf Stable Polypropylene **.50 ea.**

Crystal Microphone

Small 1" diameter ¼" thick crystal mike cartridge **$.75**

Mini RG-174 Coax

10 ft. for $1.00

Coax Connector

Chassis mount BNC type **$1.00**

9 Volt Battery Clips

Nice quality clips **5 for $1.00**
¾" Rubber Grommets **10 for $1.00**

Parts Bag

Asst. of chokes, disc caps, tant. resistors, transistors, diodes, MICA caps etc. sm. bag (100 pc) **$1.00** lg. bag (300 pc) **$2.00**

Connectors

6 pin type gold contacts for mA-1003 car clock module price **.75 ea.**

Leds

- your choice, please specify
Mini Red, Jumbo Red, High Intensity Red, Illuminator Red **8/$1**
Mini Yellow, Jumbo Yellow, Jumbo Green **6/$1**

Varactors

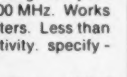
Motorola MV 2209 30 PF Nominal cap 20-80 PF - Tunable range - **.50 each or 3/$1.00**

Audio Prescaler

Make high resolution audio measurements, great for musical instrument tuning, PL tones, etc. Multiplies audio UP in frequency, selectable x10 or x100, gives .01 HZ resolution with 1 sec. gate time! High sensitivity of 25 mv, 1 meg input z and built-in filtering gives great performance. Runs on 9V battery, all CMOS.

PS-2 kit **$29.95**
PS-2 wired **$39.95**

600 MHz PRESCALER



Extend the range of your counter to 600 MHz. Works with all counters. Less than 150 mv sensitivity. specify - 10 or -100

Wired, tested, PS-1B **$59.95**
Kit, PS-1B **$44.95**

30 Watt 2 mtr PWR AMP

Simple Class C power amp features 8 times power gain. 1 W in for 8 out, 2 W in for 15 out, 4W in for 30 out. Max output of 35 W, incredible value, complete with all parts, less case and T-R relay.

PA-1, 30 W pwr amp kit **$22.95**
TR-1, RF sensed T-R relay kit **6.95**

MRF-238 transistor as used in PA-1 8-10db gain 150 mhz **$11.95**

RF actuated relay senses RF (1W) and closes DPDT relay. For RF sensed T-R relay TR-1 Kit **$6.95**

Power Supply Kit

Complete triple regulated power supply provides variable 6 to 18 volts at 200 ma and +5 at 1 Amp. Excellent load regulation, good filtering and small size. Less transformers, requires 6.3 V ct 1 A and 24 VCT.
Complete kit, PS-3LT **$6.95**

OP-AMP Special

BI-FET LF 13741 - Direct pin for pin 741 compatible, but 500,000 MEG input z, super low 50 pa input current, low power drain.

50 for only $9.00 **10 for $2.00**

Regulators

78MG	$1.25	7812	$1.00
79MG	$1.25	7815	$1.00
723	$.50	7905	$1.25
309K	$1.15	7912	$1.25
7805	$1.00	7915	$1.25

Shrink Tubing Nubs

Nice precut pces of shrink size 1" x ¼" shrink to ¼". Great for splices **50/$1.00**

Mini TO-92 Heat Sinks

Thermalloy Brand **5 for $1.00**
To-220 Heat Sinks **3 for $1.00**

Opto Isolators - 4N28 type **$.50 ea.**
Opto Reflectors - Photo diode + LED **$1.00 ea.**

Molex Pins

Molex already precut in length of 7. Perfect for 14 pin sockets. **20 strips for $1.00**

CDS Photocells

Resistance varies with light, 250 ohms to over 3 meg **3 for $1.00**

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Fontana CA

Complete lines ICOM, DenTron, Ten-Tec, Mirage, Cubic, Lunar, over 4000 electronic products for hobbyist, technician, experimenter. Also CB radio, landmobile. **Fontana Electronics, 8628 Sierra Ave., Fontana CA 92335, 822-7710.**

San Diego CA

We buy and sell Surplus Army Navy Electronics, also Terminated Material. What do you want to sell? Write for catalogue. **Electronictown, Inc., 440-7th Avenue, PO Box 2045, San Diego CA 92112, 232-9379.**

New Castle DE

Factory Authorized Dealer! Yaesu, ICOM, Ten-Tec, KDK, Azden, AEA, Kantronics, Santec. Full Line of Accessories. No Sales Tax in Delaware. One mile off I-95. **Delaware Amateur Supply, 71 Meadow Road, New Castle DE 19720, 328-7728.**

San Jose CA

Bay area's newest Amateur Radio store. New & used Amateur Radio sales & service. We feature Kenwood, ICOM, Azden, Yaesu, Ten-Tec, Santec & many more. **Shaver Radio, Inc., 1378 So. Bascom Ave., San Jose CA 95128, 998-1103.**

Smyrna GA

For your Kenwood, Yaesu, ICOM, Drake and other amateur needs, come to see us. **Britt's Two-Way Radio, 2506 N. Atlanta Rd., Smyrna GA 30080, 432-8006.**

Preston ID

Ross WB7BYZ has the Largest Stock of Amateur Gear in the Intermountain West and the Best Prices. Call me for all your ham needs. **Ross Distributing, 78 So. State, Preston ID 83263, 852-0830.**

Terre Haute IN

Your ham headquarters located in the heart of the midwest. **Hoosier Electronics, Inc., #9 Meadows Center, P.O. Box 3300, Terre Haute IN 478003, 238-1456.**

Baltimore MD

Always buying lab grade test equipment HP, Tek, Gr, L&N, Etc. Also buy microwave coaxial & waveguide HP, fxr, waveline, Etc. Prefer "K", "P", "R" but will consider larger wg too. **Cadisco 514 Ensor St. Balto, MD 21202, 685-1893.**

Littleton MA

The ham store of N.E. you can rely on. Kenwood, ICOM, Wilson, Yaesu, DenTron, KLM amps, B&W switches & wattmeters. Whistler radar detectors, Bearcat, Regency, antennas by Larsen, Wilson, Hustler, GAM. **TEL-COM Inc. Communications & Electronics. 675 Great Rd., Rt. 119, Littleton MA 01460, 486-3040.**

Ann Arbor MI

See us for products like Ten-Tec, R. L. Drake, DenTron and many more. Open Monday through Saturday, 0830 to 1730. WB8VGR, WB8UXO, WD8OKN and W8RP behind the counter. **Purchase Radio Supply, 327 E. Hoover Ave., Ann Arbor MI 48104, 668-8696.**

Hudson NH

New England's Distributor and Authorized Service Center for all Major Amateur Lines. **Tufts Radio Electronics, Inc., 61 Lowell Road, Hudson NH 03051, 883-5005.**

Somerset NJ

New Jersey's only factory-authorized ICOM and Yaesu distributor. Large inventory of new and used specials. Most major brands in stock. Complete service and facilities. **Radios Unlimited, 1760 Easton Avenue, P.O. Box 347, Somerset NJ 08873, 469-4599.**

Buffalo NY
WESTERN NEW YORK

Niagara Frontier's only full stocking Amateur dealer. Also Shortwave, CB, Scanners, Marine, Commercial. Operating displays featuring Kenwood and others. Towers, Antennas, Sales and Service. **DX Communications, 3214 Transit Road, West Seneca NY, 668-8873.**

Amsterdam NY
UPSTATE NEW YORK

Kenwood, ICOM, Drake, plus many other lines, Amateur Dealer for over 35 years. **Adirondack Radio Supply, Inc., 185 West Main Street, Amsterdam NY 12010, 842-8350.**

Syracuse-Rome-Utica NY

Featuring: Kenwood, Yaesu, ICOM, Drake, Ten-Tec, Swan, DenTron, Alpha, Robot, MFJ, Tempo, Astron, KLM, Hy-Gain, Mosley, Larsen, Cushcraft, Hustler, Mini Products. You won't be disappointed with equipment/service. **Radio World, Oneida County Airport-Terminal Building, Oriskany NY 13424, 337-0203.**

Columbus OH

The biggest and best Ham Store in the midwest featuring quality Kenwood products with working displays. We sell only the best. Authorized Kenwood Service. **Universal Amateur Radio Inc., 1280 Aida Dr., Reynoldsburg (Columbus) OH 43068, 866-4267.**

Bend OR

Satellite TV. Known brands. Call today for more information and inquire about our dealer program. **WESPERCOM, P.O. Box 7226, Bend OR 97708, 389-0996.**

Philadelphia PA/
Camden NJ

Waveguide & Coaxial Microwave Components & Equipment. Laboratory Grade Test Instruments, Power Supplies, Buy, Sell & Trade all popular makes—HP, GR, FXR, ESI, Sorensen, Singer, etc. **Lectronic Research Labs, 1423 Ferry Ave., Camden NJ 08104, 541-4200.**

Scranton PA

ICOM, Bird, Cushcraft, Beckman, Fluke, Larsen, Hustler, Antenna Specialists, Astron, Avanti, Belden, W2AU/W2VS, CDE, AEA, Vibroplex, Ham-Key, CES, Amphenol, Sony, Fanon/Courier, B&W, Ameco, Shure. **LaRue Electronics, 1112 Grandview St., Scranton PA 18509, 343-2124.**

Dallas TX

Dealer in Used Computer Hardware & Electronic Parts. Special on Daisy Wheel Printers. Xerox Word Processing Equipment, Dual Card Printers and Display Systems. Catalog $1.00. **Rondure Company (The Computer Room) Dept. 73, 2522 Butler St., Dallas TX 75235, 630-4621.**

San Antonio TX

Amateur, Commercial 2-way. Selling Antenna Specialists, Avanti, Azden, Bird, Hy-Gain, Standard, Vibroplex, Midland, Henry, Cushcraft, Dielectric, Hustler, ICOM, MFJ, Nye, Shure, Cubic, Tempo, Ten-Tec and others. **Appliance & Equipment Co., Inc. 2317 Vance Jackson Road, San Antonio TX 78213, 734-7793.**

DEALERS

Your company name and message can contain up to 25 words for as little as $150 yearly (prepaid), or $15 per month (prepaid quarterly). No mention of mail-order business or area code permitted. Directory text and payment must reach us 60 days in advance of publication. For example, advertising for the Dec. '82 issue must be in our hands by Oct. 1st. Mail to 73 Magazine, Peterborough NH 03458. ATTN: Nancy Ciampa.

PROPAGATION

J. H. Nelson
4 Plymouth Dr.
Whiting NJ 08759

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14A	14	7	7	7	7	3A	7	14	14A	14A	21
ARGENTINA	21	14	14	7A	7	7	14A	21A	21A	21A	21A	21A
AUSTRALIA	21A	14	14	7B	7B	7B	7B	14B	14	14	21A	21A
CANAL ZONE	21	14	7	7	7	7	14	21A	21A	21A	21A	21A
ENGLAND	7A	7	7	7	7B	7A	14	21A	21A	21A	14A	14
HAWAII	21A	14	7	7	7	7	7	7	14	21	21A	21A
INDIA	7B	7B	7B	7B	7B	7B	14	21A	14	14	14	7B
JAPAN	14A	14	7B	7B	7B	7B	7	7	7B	7B	14	21A
MEXICO	21	14	7	7	7	7	7	14	21A	21A	21A	21A
PHILIPPINES	14	14	7B	7B	7B	7B	14B	14	14	14	14	21
PUERTO RICO	14	7A	7	7	7	7	14	21	21A	21A	21	14A
SOUTH AFRICA	14	7A	7	7B	7B	14	21	21A	21A	21A	21A	21
U. S. S. R.	7	7	7	7	7B	7B	14	21A	21A	14	14	7B
WEST COAST	21A	14	7A	7	7	7	7	14	21A	21A	21A	21A

CENTRAL UNITED STATES TO:

ALASKA	14A	14	7	7	7	7	3A	7	14	14A	14A	21
ARGENTINA	21A	14	14	7A	7	7	14	21	21A	21A	21A	21A
AUSTRALIA	21A	21	14	7B	7B	7B	7B	14B	14	14	21A	21A
CANAL ZONE	21	14	7	7	7	7	14	21A	21A	21A	21A	21A
ENGLAND	7A	7	7	7	7B	7B	14B	14A	21A	21A	14	14
HAWAII	21A	21	14	7	7	7	7	7	14	21	21A	21A
INDIA	14	14	7B	7B	7B	7B	7B	14B	14	14	14	7B
JAPAN	21A	14	7B	7B	7B	7	7	7	7B	7B	14	21A
MEXICO	14A	14	7	7	7	7	7	14	21	21A	21A	21
PHILIPPINES	21	14	7B	7B	7B	7B	7B	7B	14	14	14	21
PUERTO RICO	21	14	7	7	7	7	14	21	21A	21A	21A	21A
SOUTH AFRICA	14	7A	7	7B	7B	7B	14	21A	21A	21A	21A	21
U. S. S. R.	7	7	7	7	7B	7B	7B	14	21A	14	14	7B

WESTERN UNITED STATES TO:

ALASKA	14A	14	7	7	7	7	3A	7	7	14	14A	21
ARGENTINA	21A	14	14	7A	7	7	7B	21	21A	21A	21A	21A
AUSTRALIA	21A	21A	14A	14	14B	7B	7B	7B	14	14	21A	21A
CANAL ZONE	21	14	7	7	7	7	7	21	21A	21A	21A	21A
ENGLAND	7	7	7	7	7B	7B	7B	14	21A	21	14	14
HAWAII	21A	21	14A	14	7	7	7	7	14	21	21A	21A
INDIA	14	21	14B	7B	7B	7B	7B	14	14	14	14	7B
JAPAN	21A	21	14	14B	7B	7	7	7	7	7	14	21A
MEXICO	21A	14	7	7	7	7	7	14	21	21A	21A	21A
PHILIPPINES	21A	14A	14	7B	7B	7B	7B	7	14	14	14	21A
PUERTO RICO	21A	14	7	7	7	7	7	21	21A	21A	21A	21A
SOUTH AFRICA	14	7A	7	7B	7B	7B	7B	14	21A	21A	21A	21
U. S. S. R.	7B	7	7	7	7B	7B	7B	14	14	14	14	7B
EAST COAST	21A	14	7A	7	7	7	7	14	21A	21A	21A	21A

A = Next higher frequency may also be useful.
B = Difficult circuit this period.

First letter = night waves. Second = day waves.
G = Good, F = Fair, P = Poor. * = Chance of solar flares.
 # = Chance of aurora.

NOTE THAT NIGHT WAVE LETTER NOW COMES FIRST.

OCTOBER

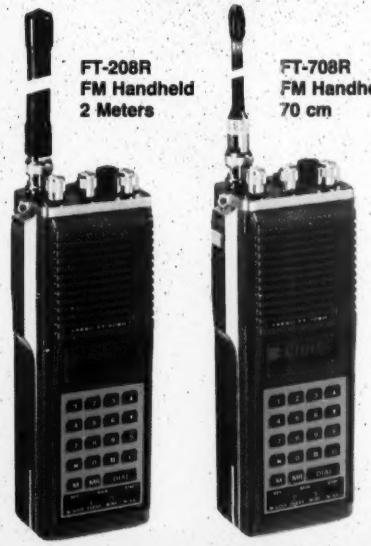
SUN	MON	TUE	WED	THU	FRI	SAT
					1 G/G	2 F/G
3 F/G	4 G/G	5 G/G	6 G/G	7 F/G	8 F/G	9 F/F
10 F/F	11 F/F	12 F/G	13 G/G	14 G/G	15 G/G	16 G/G
17 G/G*	18 F/F*	19 P/F**	20 P/F**	21 P/F*	22 F/G	23 F/G
24 F/F* 31 G/G	25 P/F**	26 P/F**	27 F/F	28 G/G	29 G/G	30 G/G

FT-230R: QUITE A SIGHT! (AND EASY TO SEE, TOO!!)

Sporting an all-new Liquid Crystal Display, the FT-230R is Yaesu's high-performance answer to your call for a very affordable 2 meter mobile rig with an easy-to-read frequency display! The FT-230R combines microprocessor convenience, a sensitive receiver, a powerful yet clean transmitter strip, and the new dimension of LCD frequency readout. See your Authorized Yaesu Dealer today — and go home with your new FT-230R!

SALE SUBJECT FCC CERTIFICATION

- LCD five-digit frequency readout with night light for high visibility day or night.
- Two VFOs for quick QSY across the band.
- Ten memory slots for storage and recall of favorite channels.
- Selectable synthesizer steps (5 kHz or 10 kHz) in dial or scanning mode.
- Priority channel for checking a favorite frequency for activity while monitoring another.
- Unique VFO/Memory Split mode for covering unusual repeater splits.
- Up/Down band scan plus memory scan for busy or clear channel. Scanning microphone included in purchase price.
- Full 25 watts of RF power output from extremely compact package.
- Built-in automatic or manual tone burst.
- Optional synthesized CTCSS Encode and Encode/Decode boards available.
- Lithium memory backup battery with estimated lifetime of five years.
- Optional YM-49 Speaker/Microphone and YM-50 DTMF Encoding Microphone provide maximum operating versatility.



FT-208R
FM Handheld
2 Meters

FT-708R
FM Handheld
70 cm

And don't forget! Yaesu has a complete line of VHF and UHF handheld and battery portable transceivers using LCD display!!!

FT-290R - 2 Meters
SSB/CW/FM Portable

FT-690R - 6 Meters
USB/CW/AM/FM Portable

YAESU
The radio.

Price and Specifications Subject To Change Without Notice or Obligation

482

YAESU ELECTRONICS CORP. 6851 Walthall Way, Paramount, CA 90723 • (213) 633-4007
Eastern Service Ctr., 9812 Princeton-Glendale Rd., Cincinnati, OH 45246 • (513) 874-3100

Watts to see...

Big LCD, Big 45 W, Big 21 memories, compact.

TR-7950

Outstanding features providing maximum ease of operation include a large, easy-to-read (direct sunlight or dark) LCD display, 21 multi-function memories, automatic offset, programmable priority channel, memory and band scans, built-in lithium battery memory back-up, built-in 16-key autopatch, and a choice of a hefty 45 watts output (TR-7950), or 25 watts output (TR-7930).

TR-7950 FEATURES:

- **NEW, large, easy-to-read LCD digital display**
  Easy to read in direct sunlight or dark (back-lighted). Displays transmit/receive frequencies, memory channel, repeater offset, (+,S,−), sub-tone number (F-0, 1, 2, 3), tone, scan, and memory scan lock-out. Includes LED S/RF bar meter, and LED indicators for REVERSE, CENTER TUNING, PRIORITY, and ON AIR.
- **21 NEW, multi-function memory channels**
  Stores frequency, repeater offset, and optional sub-tone channels. Memories 1 through 15 for simplex or ± 600 kHz offset. Memory pairs 16/17, and 18/19 are paired for non-standard repeater offset. Memories "A" and "B" set upper and lower scan limits, or for simplex or ± 600 kHz offset. In MEMORY mode, a circle of light appears around the memory selector knob. When the memory selector knob is rotated in either direction to channel 1, an audible "beep" will sound.
- **Choice of 45 or 25 watts output**
  The TR-7950 provides a hefty 45 watts output, while the TR-7930 features a more modest 25 watts. A HI/LOW power switch allows power reduction to approx. 5 watts.
- **Long-life lithium battery memory back-up**
  Built-in lithium battery has an estimated 5 year life.
- **Automatic offset**
  The microprocessor is pre-programmed for simplex or ± 600 kHz offset, in accordance with the 2 meter band plan. "OS" key allows manual change in offset.
- **Programmable priority alert**
  The PRIORITY channel may be programmed in any of the 21 memories. With ALERT switch "ON," a dual "beep" sounds when a signal is present on the PRIORITY channel. An OPER switch allows an easy move to the PRIORITY channel.
- **Programmable memory scan lock-out**
  "LO" key for programming scan to skip selected memory channels, without erasing the memory.
- **Programmable band-scan width**
  The lower limit may be programmed into memory "A," and the upper limit into memory "B."
- **Center stop during band-scan, with indicator**
  Stops in center of channel during band-scan, with center tuning indicator.
- **Scan resume selectable**
  Scan stops on busy channel. Selectable automatic time resume-scan (approx. 5 sec., adjustable), or carrier operated resume-scan. A scan delay of approx. 1.5 seconds built-in.
- **Scan control using up/down microphone**
  Momentarily pressing UP or DOWN button on microphone tunes one step in the selected direction, on memory or on 5-kHz step tuning. Holding the button for about 2 seconds starts UP or DOWN automatic scan action. Scan start also possible using "SC" key on keyboard. Scan may be cancelled by momentarily pressing the PTT switch, or by pressing both UP/DOWN buttons simultaneously.
- **Programmable sub-tone channels**
  Optional TU-79 3 frequency sub-tone unit provides keyboard selectable sub-tone channels, which may be stored in memory.
- **Built-in 16-key autopatch, with monitor**
  The keyboard functions as a 16-key autopatch during transmit. DTMF tones appear in the speaker output when a key is pressed during transmit.
- **Front panel keyboard control**
  Used for selecting frequency, offset, programming memories, controlling scan, and autopatch encode. Keyboard lighting is provided.
- **Extended frequency coverage**
  Covers 142.000-148.995 MHz, in 5-kHz steps.
- **Repeater reverse switch**
  Locking-type switch, with indicator.
- **"Beeper" amplified through speaker**
- **Compact, lightweight design**
- **Easy-to-install adjustable-angle mobile mounting bracket**

Optional accessories:

- TU-79 3 frequency tone unit.
- KPS-12 fixed-station power supply for TR-7950.
- KPS-7 fixed-station power supply for TR-7930.
- SP-40 compact mobile speaker.

More information on the TR-7950 and TR-7930 is available from all authorized dealers of Trio-Kenwood Communications, 1111 West Walnut Street, Compton, California 90220.

KENWOOD
...pacesetter in amateur radio

Specifications and prices are subject to change without notice or obligation.